RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
RV Vidyaniketan Post, Mysuru Road
Bengaluru – 560059

Scheme and Syllabus of III & IV Semester

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)
in
MACHINE DESIGN

DEPARTMENT OF
MECHANICAL ENGINEERING

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
2. To create a conducive environment for interdisciplinary research and innovation.
3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work and Innovation

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Master of Technology (M.Tech)
in
MACHINE DESIGN

DEPARTMENT OF
MECHANICAL ENGINEERING

DEPARTMENT OF
MECHANICAL ENGINEERING

VISION

Quality education in Design, Materials, Thermal and Manufacturing with emphasis on research, sustainable technologies and entrepreneurship for societal symbiosis.

MISSION

1. Imparting knowledge in basic and applied areas of Mechanical Engineering.
2. Providing state-of-the-art laboratories and infrastructure for academics and research in the areas of design, materials, thermal engineering and manufacturing.
3. Facilitating faculty development through continuous improvement programs.
4. Promoting research, education and training in materials, design, manufacturing, Thermal Engineering and other multidisciplinary areas.
5. Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy.
6. Imbibing social and ethical values in students, staff and faculty through personality development programs

PROGRAMME OUTCOMES (PO)

M.Tech in Machine Design graduates will be able to:

PO1: An ability to independently carry out a research / investigation and development work to solve practical problems related to machine design.

PO2: An ability to write and present a substantial technical report / document

PO3: An ability to demonstrate a degree of mastery over the areas of machine design. The mastery should be at a level higher than the requirements in the BE Mechanical Engineering and allied programs

PO4: An ability to use modern tools for the design and analysis of static and dynamic systems and mechanisms

PO5: An ability to adapt technical, safety, ethical and environmental factors in the design of system and mechanism

PO6: An ability to perform in multidisciplinary teams with sound interpersonal and management skills with a commitment to lifelong learning

ABBREVIATIONS

Sl. No.	Abbreviation	Acronym
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics
23.	MCA	Master of Computer Applications
24.	MST	Structural Engineering
25.	MHT	Highway Technology
26.	MPD	Product Design & Manufacturing
27.	MCM	Computer Integrated & Manufacturing
28.	MMD	Machine Design
29.	MPE	Power Electronics
30.	MVE	VLSI Design & Embedded Systems
31.	MCS	Communication Systems
32.	MBS	Bio Medical Processing Signal & Instrumentation
33.	MCH	Chemical Engineering
34.	MCE	Computer Science & Engineering
35.	MCN	Computer Network Engineering
36.	MDC	Digital Communication
37.	MRM	Radio Frequency and Microwave Engineering
38.	MSE	Software Engineering
39.	MIT	Information Technology
40.	MBT	Biotechnology
41.	MBI	Bioinformatics

CONTENTS

RV COLLEGE OF ENGINEERING®, BENGALURU - 560059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech in MACHINE DESIGN

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MMD31	Fracture Mechanics	ME	4	1	0	**5**
2	18MMD32	Internship	ME	0	0	5	**5**
3	18MMD33	Major Project : Phase-I	ME	0	0	5	**5**
4	18XXX 3EX	Elective-E	ME	4	0	0	**4**
Total number of Credits				**8**	**1**	**10**	**19**
Total Number of Hours/Week				**8**	**2**	**20**	

SEMESTER : III		
GROUP E: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1	18MMD3E1	Mechatronics System Design
2	18MPD3E2	Surface Engineering
3	18MMD3E3	Experimental Mechanics

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MMD41	Major Project : Phase-II	ME	0	0	20	**20**
2	18MMD42	Technical Seminar	ME	0	0	2	**2**
Total number of Credits				**0**	**0**	**22**	**22**
Total Number of Hours / Week				**0**	**0**	**44**	

SEMESTER: III						
FRACTURE MECHANICS (Theory)						
Course Code	**:**	**18MMD31**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L+26T**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **10 Hrs**

Introduction: The Fracture Mechanics Approach to Design, Early Fracture Research, Historical Perspective The Liberty Ships, Post-War Fracture Mechanics Research, , The Energy Criterion, The Stress-Intensity Approach, Time-Dependent Crack Growth and Damage Tolerance, Effect of Material Properties on Fracture, A Brief Review of Dimensional Analysis.

Linear Elastic Fracture Mechanics, An Atomic View of Fracture, Stress Concentration Effect of Flaws, The Griffith Energy Balance, Comparison with the Critical Stress Criterion, Modified Griffith Equation, The Energy Release Rate, Instability and the R-Curve, Reasons for the R-Curve Shape, Load Control vs. Displacement Control, Structures with Finite Compliance, Stress Analysis of Cracks, The Stress Intensity Factor, Relationship between K and Global Behaviour, Effect of Finite Size , Principle of Superposition, Weight Functions, Relationship between K and G

Unit – II **10 Hrs**

Crack-Tip Plasticity: The Irwin Approach, The Strip-Yield Model, Comparison of Plastic Zone Corrections, Plastic Zone Shape, K -Controlled Fracture, Plane Strain Fracture: Fact vs. Fiction, Crack tip Triaxiality, Effect of Thickness on Apparent Fracture Toughness, Plastic Zone Effects, Implications for Cracks in Structures.

Mixed-Mode Fracture: Propagation of an Angled Crack, Equivalent Mode I Crack, Bi-axial Loading. Interaction of Multiple Cracks, Coplanar Cracks, Parallel Cracks. Mathematical Foundations of Linear Elastic Fracture Mechanics, Plane Elasticity, Cartesian Coordinates, Polar Coordinates, Crack Growth Instability Analysis, Crack-Tip Stress Analysis, Generalized In-Plane Loading, The Westergaard Stress Function.

Unit – III **10 Hrs**

Elastic-Plastic Fracture Mechanics: Crack-Tip-Opening Displacement, The Contour Integral, J as a Path-Independent Line Integral , J as a Stress Intensity Parameter , The Large Strain Zone , Laboratory Measurement of J , Relationships Between J and CTOD, Crack-Growth Resistance Curves, Stable and Unstable Crack Growth, Computing J for a Growing Crack, J-Controlled Fracture.

Dynamic and Time Dependent Fracture: Dynamic Fracture and Crack Arrest, Rapid Loading of a stationary crack, Rapid Crack Propagation and Arrest, Crack Speed, Elastodynamic crack-tip parameters, Dynamic Toughness, Crack Arrest, Dynamic Contour Integrals

Unit – IV **12 Hrs**

Application to Structures: K_I for Part-Through cracks, influence coefficients for polynomial stress distributions, weight functions for arbitrary loading, primary, secondary and residual stresses. CTOD design curve, Failure Assessment Diagrams (FAD), original concept, J-based FAD, application to welded structures, incorporating weld residual stresses, weld misalignment, weld strength mismatch. Primary vs. Secondary stresses in FAD Method, Ductile-tearing Analysis with FAD.

Fatigue Crack Propagation, Similitude in Fatigue, Empirical Fatigue Crack Growth Equations, Crack Closure , A Closer Look at Crack-Wedging Mechanisms, Effects of Loading Variables on Closure, The Fatigue Threshold, The Closure Model for the Threshold, A Two-Criterion Model, Threshold Behaviour in Inert Environments, Variable Amplitude Loading and Retardation, Linear Damage Model for Variable Amplitude Fatigue, Reverse Plasticity at the Crack Tip, The Effect of Overloads and Under loads , Models for Retardation and Variable Amplitude Fatigue.

Unit –V	10 Hrs
Fracture Testing of Metals & Non-Metals: General Considerations, specimen configurations, Specimen orientation, Fatigue Precracking, Instrumentation, Side grooving, K_{IC} testing, ASTM E399, K-R Curve Testing, Specimen design, experimental measurement of K-R curves, J-testing of metals, CTOD testing, Fracture testing of weldments. Fracture Toughness Measurements in Engineering Plastics, K_{Ic} Testing, J-Testing, Qualitative Fracture Tests on Plastics. **Computational Fracture Mechanics**, Overview of Numerical Methods, The Finite Element Method, The Boundary Integral Equation Method, Traditional Methods in Computational Fracture Mechanics, Stress and Displacement Matching, Elemental Crack Advance, Contour Integration, Virtual Crack Extension: Stiffness Derivative Formulation, Virtual Crack Extension: Continuum Approach.	
Course Outcomes **After going through this course the student will be able to:** CO1: Demonstrate the material failure for any combination of applied stresses CO2: Ability to Assess the failure conditions of a structure CO3: Determine the stress intensity factor for simple components of simple geometry CO4: To conduct fracture testing of metals & non-metals and learn computational fracture mechanics using FEM	
Reference Books:	
1	Fracture Mechanics: Fundamentals and Applications, T. L. Anderson, Taylor and Francis Fourth Edition, 2005. ISBN: 977-3-735689-37-8
2	Elementary Engineering Fracture Mechanics, David Broek, Kluwer Academic Publishers, 4th revised edition. ISBN: 978-1-935159-47-9
3	Elements of Fracture Mechanics, Prashanth Kumar, Tata McGraw-Hill Education, 2009 ISBN: 077-1-732682-17-2
4	Fracture Mechanics, E.E. Gdoutos, Kluwer Academic Publishing, Boston, 1993. ISBN: 947-1-272683-32-9

Continuous Internal Evaluation (CIE): Total marks: 100

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : III						
INTERNSHIP						
Course Code	**:**	**18MMD32**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1) The duration of the internship shall be for a period of 8 weeks on full time basis after II semester final exams and before the commencement of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization : Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed : summaries the tasks performed during 8 week period
    - Chapter 4 – Reflections : Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

Course Outcomes

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments,	45%
Review-II	Importance of resource management, environment and sustainability presentation skills and report writing	55%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

SEMESTER : III						
MAJOR PROJECT : PHASE-I						
Course Code	**:**	**18MMD33**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1. The Major Project work comprises of Phase-I and Phase-II. Phase-I is to be carried out in third semester and Phase-II in fourth semester.
2. The total duration of the Major project Phase-I shall be for 16 weeks.
3. Major project shall be carried out on individual student basis in his/her respective PG programme specialization. Interdisciplinary projects are also considered.
4. The allocation of the guides shall be preferably in accordance with the expertise of the faculty.
5. The project may be carried out on-campus/industry/organization with prior approval from Internal Guide, Associate Dean and Head of the Department.
6. Students have to complete Major Project Phase-I before starting Major Project Phase-II.
7. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the students will be able to:

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Selection of the topic, Literature Survey, Problem Formulation and Objectives	45%
Review-II	Methodology and Report writing	55%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-I evaluation shall be done by an external examiner (domain expert) and respective guide as per the schedule. Maximum of four candidates per batch shall be allowed to take examination. The batches are to be formed based on specific domain of work.

SEMESTER : III						
MECHATRONICS SYSTEM DESIGN (Elective-E1)						
Course Code	**:**	**18MMD3E1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I **10 Hrs**

Introduction: Definition, Multidisciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics.

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall effect sensors.

Unit – II **10 Hrs**

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8086A Microprocessor**.**

Unit – III **10 Hrs**

Programmable logic controller: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching & selection of a PLC

Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot.

Unit – IV **10 Hrs**

Mechanical actuation systems: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain drives, mechanical aspects of motor selection.

Electrical actuation systems: Electrical systems, Mechanical switches, Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servo motors**.**

Unit – V **12 Hrs**

Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve, Cylinders and rotary actuators.

DCV & FCV- Principle & construction details, types of sliding spool valve, solenoid operated, Symbols of hydraulic elements, components of the hydraulic system, functions of various units of hydraulic system. Design of simple hydraulic circuits for various applications.

Course Outcomes

After going through this course the student will be able to:

CO1: Define and illustrate the various components of Mechatronics system.
CO2: Identify, Categorize and apply transducers and sensors used in automation, control system and instruments
CO3: Assess various control systems used in automation.
CO4: Develop mechanical, hydraulic, pneumatic and electrical based circuit systems.

Reference Books:

1.	Mechatronics-Principles, Concepts and Applications, Nitaigour Premchand Mahalik, Tata McGraw Hill, 1st Edition, 2003, ISBN No. 0071239243.
2.	Mechatronics by HMT Ltd., Tata McGraw Hill, 1st Edition, 2000, ISBN No. 9780074636435.
3.	Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering, W. Bolton, Pearson Education, 1st Edition, 2005, ISBN No.81-7758-284-4.
4.	Fluid Power, Anthony Esposito, Pearson Education-Sixth Edition-2011, ISBN N0:9789332518544

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : III						
SURFACE ENGINEERING (Elective-E2)						
Course Code	**:**	**18MPD3E2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10 Hrs**
Introduction Tribology, surface degradation, wear and corrosion, types of wear, roles of friction and lubrication- overview of different forms of corrosion, introduction to surface engineering, importance of substrate	
Unit – II	**10 Hrs**
Chemical and electrochemical polishing, significance, specific examples, chemical conversion coatings, phosphate, chromating, chemical coloring, anodizing of aluminum alloys, thermo chemical processes - industrial practices	
Unit – III	**11 Hrs**
Surface pre-treatment, deposition of copper, zinc, nickel and chromium - principles and practices, alloy plating, electro composite plating, electroless plating of copper, nickel phosphorous, nickel-boron; electroless composite plating; application areas, properties, test standards (ASTM) for assessment of quality deposits.	
Unit – IV	**11 Hrs**
Definitions and concepts, physical vapour deposition (PVD), evaporation, sputtering, ion plating, plasma nitriding, process capabilities, chemical vapour deposition (CVD), metal organic CVD, plasma assisted CVD, specific industrial applications	
Unit – V	**10 Hrs**
Thermal spraying, techniques, advanced spraying techniques - plasma surfacing, D-Gun and high velocity oxy-fuel processes, laser surface alloying and cladding, specific industrial applications, tests for assessment of wear and corrosion behavior.	

Course Outcomes

After going through this course the student will be able to:

CO1: Explain various forms of corrosion and basic concepts of surface engineering
CO2: Evaluate the different surface engineering processes with respect to industrial practices
CO3: Apply the knowledge of different spraying techniques in surface engineering
CO4: Analyze tests for assessment of wear and corrosion behavior.

Reference Books

1	Surface modification technologies - An Engineer's guide, Sudarshan T S, Marcel Dekker, Newyork, 1989
2	Electroplating and Other Surface Treatments - A Practical Guide, Varghese C.D, TMH, 1993
3	Surface Engineering Practice, Processes, Fundamentals and Applications in Corrosion and Wear, Strafford, K.N., Datta, P.K., and Gray, J.S., Ellis Harwood (1990).
4	Advanced Surface Coatings: A Hand book of Surface Engineering, Mathews, A., Spinger (1991).

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : III						
EXPERIMENTAL MECHANICS (Elective-E3)						
Course Code	**:**	**18MMD3E3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit–I **10 Hrs**

Introduction: Definition of terms, calibration, standards, dimensions and units, generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experiment planning.

Analysis of Experimental Data: Cause and types of experimental errors, error analysis. Statistical analysis of experimental data- Probability distribution, Gaussian, normal distribution. Chi-square test, Method of least square, correlation coefficient, multivariable regression, standard deviation of mean, graphical analysis and curve fitting, general consideration in data analysis.

Unit–II **12 Hrs**

Data Acquisition and Processing: General data acquisition system, signal conditioning revisited, data transmission, Analog-to-Digital and Digital-to- Analog conversion, Basic components (storage and display) of data acquisition system. Computer program as a substitute for wired logic.

Force, Torque and Strain Measurement: Mass balance measurement, Elastic Element for force measurement, torque measurement. Strain Gages -Strain sensitivity of gage metals, Gage construction, Gage sensitivity and gage factor, Performance characteristics, Environmental effects Strain, gage circuits, Potentiometer, Wheat Stone's bridges, Constant current circuits. Strain Analysis Methods-Two element and three element, rectangular and delta rosettes, Correction for transverse strains effects, stress gage - plane shear gage, Stress intensity factor gage.

Unit–III **10 Hrs**

Photoelastic Stress Analysis: Two Dimensional Photo elasticity - Nature of light, - wave theory of light - optical interference - Polariscopes Stress-optic law- effect of stressed model in plane and circular Polariscopes.

Isoclinic Iso chromatics fringe order determination – Fringe multiplication techniques - Calibration of Photoelastic model materials. Separation methods shear difference method, Analytical separation methods, Model to prototype scaling**.**

Unit–IV **10 Hrs**

Three Dimensional Photo elasticity: Stress freezing method, General slice, Effective stresses, Stresses separation, Shear deference method, Oblique incidence method Secondary principals stresses, Scattered light photo elasticity, Principles, Polari scope and stress data analyses.

Coating Methods: Photoelastic Coating Method-Birefringence coating techniques Sensitivity Reinforcing and thickness effects - data reduction - Stress separation techniques Photoelastic strain gauges. Brittle Coatings Method: Brittle coating technique Principles data analysis - coating materials, Coating techniques.

Unit–V **10 Hrs**

Moiré Technique - Geometrical approach, Displacement approach- sensitivity of moiré data reduction, In plane and out plane moiré methods, Moiré photography, moiré grid production.

Holography: Introduction, Equation for plane waves and spherical waves, Intensity, Coherence, Spherical radiator as an object (record process), Hurter, Driffeld curves, Reconstruction process, Holographic interferometry, Real-time and double exposure methods, Displacement measurement, Isopachics.

Course Outcomes **After going through this course the student will be able to:** CO1: Understand experimental investigations to verify predictions by other methods. CO2: Ability to acquire skills for experimental investigations CO3: To provide a detailed knowledge of modern full field techniques such as Photoelastic Stress Analysis (PSA), Three Dimensional Photo elasticity (TDP) CO4: Explain different types of coatings, test strain data using brittle coating and birefringent coating & holographic techniques	
Reference Books:	
1	Experimental Methods for Engineers, Holman, 7th Edition, Tata McGraw-Hill Companies, Inc, New York, 2007
2	Mechanical measurements, R. S. Sirohi, H. C. Radha Krishna, New Age International Pvt. Ltd., New Delhi, 2004
3	Experimental Stress Analysis, Srinath, Lingaiah, Raghavan, Gargesa, Ramachandra, Pant, Tata McGraw Hill, 1984.
4	Instrumentation, Measurement And Analysis, Nakra & Chaudhry, B C Nakra K K Chaudhry, Tata McGraw-Hill Companies, Inc, New York, Seventh Edition, 2006.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER: IV						
MAJOR PROJECT : PHASE-II						
Course Code	**:**	**18MMD41**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:20**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**40**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1. Major Project Phase-II is continuation of Phase-I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of methodology, algorithm development, experimentation, testing and analysis of results.
4. It is mandatory for the student to present/publish the work in National/International conferences or Journals
5. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the students will be able to:

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning.

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Review and refinement of Objectives, Methodology and Implementation	20%
Review-II	Design, Implementation and Testing	40%
Review-III	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report and CIE marks.

Stage-1 Report Evaluation

Evaluation of Project Report shall be done by guide and an external examiner.

Stage-2 Project Viva-voce

Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

Both Stage-1 and Stage-2 evaluations shall be completed as per the evaluation formats.

SEE procedure is as follows:

	Internal Guide	**External Examiner**	**TOTAL**	
SEE Report Evaluation	100 marks	100 marks		200 marks
			(A)	(200/2) = 100 marks
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator		(B)	100 marks
			Total Marks	**[(A)+(B)]/2 = 100**

SEMESTER : IV						
TECHNICAL SEMINAR						
Course Code	**:**	**18MMD42**		**CIE Marks**	**:**	**50**
Credits L:T:P	**:**	**0:0:2**		**SEE Marks**	**:**	**50**
Hours/Week	**:**	**4**		**SEE Duration**	**:**	**30 Mins**

GUIDELINES

1) The presentation shall be done by individual students.
2) The seminar topic shall be in the thrust areas of respective PG programs
3) The seminar topic could be complementary to the major project work
4) The student shall bring out the technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation along with the report.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the student will be able to:

CO1: Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study.
CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable.

Scheme of Continuous Internal Evaluation (CIE): Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Selection of Topic, Review of literature, Technical Relevance, Sustainability and Societal Concerns, Presentation Skills	45%
Review-II	Technological Developments, Key Competitors, Report writing	55%

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.