Sanjay Ghodawat University Kolhapur *9 May 2018.*

First Year M. Tech. Mechanical Engineering-Design(2018-19) R0

Academic Year:2018-19**Syllabus Structure and Contents**

Structure for M.Tech. Mechanical Engineering – Design

Semester I									
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	Evaluation Scheme for Theory and Practical			
						Compo -nent	**Exam**	**WT %**	**Pass**
MMD501 (UC | ST) Version: 1.0	Research Methodology	3	1	-	4	Th (100)	FET CAT I CAT II ESE	20 15 15 50	Min 40
MMD 503 (PC 1| ST) Version: 1.0	Advanced Engineering Materials	3	1	-	4	Th (100)	FET CAT I CAT II ESE	20 15 15 50	Min 40
MMD 505 (PC 2| ST) Version: 1.0	Advanced Solid Mechanics	3	1	-	4	Th (100)	FET CAT I CAT II ESE	20 15 15 50	Min 40
MMD 507 (PC 3| ST) Version: 1.0	Advanced Machine Design	3	1	-	4	Th (100)	FET CAT I CAT II ESE	20 15 15 50	Min 40
MMD 509.x (PE | ST) Version: 1.0	Program Elective I	3	1	-	4	Th (100)	FET CAT I CAT II ESE	20 15 15 50	Min 40
MMD 511 (PC 4| ST) Version: 1.0	Measurements & Analysis Lab	-	-	2	1	Pr (100)	FEP ESE	50 50	Min 40
MMD 513 (PC 5| ST) Version: 1.0	CAD &Analysis Lab	-	-	2	1	Pr (100)	FEP ESE	50 50	Min 40
MMD 515 (PC 6| ST) Version: 1.0	Seminar I	-	-	2	1	Pr (100)	FEP ESE	50 50	Min 40
	Total	**15**	**05**	**06**	**23**	**Total Hrs: 26, Total Credits: 23**			

L: Lecture, T: Tutorial, Pr: Practical, C: Credits, Th. : Theory, WT: Weight, PC: Program Core, PE: Program Elective, UC: University Core, UE: University Elective, ST: School of Technology, SS: School of Sciences, SC: School of Commerce, SM: School of Management, SA: School of Arts
FET: Faculty Evaluation Theory, CAT: Continuous Assessment Test, ESE End Semester Examination, TW : Term Work, POE : Practical Oral Examination.

Academic Year 2018-19 **Syllabus Structure and Contents**

Semester II									
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	Evaluation Scheme for Theory and Practical			
						Compo -nent	**Exam**	**WT %**	**Pass**
MMD 502 (PC 7| ST) Version: 1.0	Analysis and Synthesis of Mechanisms	3	1	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	
MMD 504 (PC 8| ST) Version: 1.0	Design Optimization	3	1	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	
MMD 506 (PC 9| ST) Version: 1.0	Advanced Machine Tool Design	3	1	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	
MMD 508 (PC 10| ST) Version: 1.0	Noise, Vibration and Harshness	3	1	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	
MMD 510.x (PE | ST) Version: 1.0	Program Elective II	3	1	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	
MMD 512 (PC 11| ST) Version: 1.0	Analysis & Synthesis Lab	-	-	2	1	Pr (100)	FEP	50	Min 40
							ESE	50	
MMD 514 (PC 12| ST) Version: 1.0	Noise, Vibration and Harshness Lab	-	-	2	1	Pr (100)	FEP	50	Min 40
							ESE	50	
MMD 516 (PC 13| ST) Version: 1.0	Seminar II	-	-	2	1	Pr (100)	FEP	50	Min 40
							ESE	50	
	Total	**15**	**05**	**06**	**23**	**Total Hrs: 26, Total Credits: 23**			

L: Lecture, T: Tutorial, Pr: Practical, C: Credits, Th. : Theory, WT: Weight Age
PC: Program Core, PE: Program Elective, UC: University Core, UE: University Elective
ST: School of Technology, SS: School of Sciences, SC: School of Commerce, SM: School of Management, SA: School of Arts
FET: Faculty Evaluation Theory, CAT: Continuous Assessment Test, ESE End Semester Examination, TW : Term Work, POE : Practical Oral Examination

Academic Year 2018-19 **Syllabus Structure and Contents**

ODD	**Second Year : Semester – III**								
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme for (L T P)**			
						Component	**Exam**	**WT %**	**Min Pass %**
MMD601 (PC | ST) Version: 1.0	Industry Internship				**4**	**P (100)**	ISE	50	50
							ESE	50	
MMD603 (PC | ST) Version: 1.0	Dissertation Phase I				**4**	**P (100)**	ISE	100	50
MMD605 (PC | ST) Version: 1.0	Dissertation Phase II				**8**	**P (100)**	ISE	50	50
							ESE	50	
	TOTAL				**16**	**Total Credits : 16**			

EVEN	**Second Year : Semester – IV**								
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme for (L T P)**			
						Component	**Exam**	**WT %**	**Min Pass%**
MMD602 (PC | ST) Version: 1.0	Dissertation Phase III				**8**	Presentation & Demonstration	ISE	100	50
MMD604 (PC | ST) Version: 1.0	Dissertation Phase IV				**8**	Viva Voce Exam	ESE	100	50
MMD606 (PC | ST) Version: 1.0	Dissertation Outcome Dissemination				**2**	Publications and Patents	ESE	100	50
	TOTAL				**18**	**Total Credits : 18**			

Structure for M. Tech. Mechanical Engineering – Design

Program Elective-I

Course Code	Course Title
MMD 509.1 (PE | ST) Version: 1.0	Experimental Stress Analysis
MMD 509.2 (PE | ST) Version: 1.0	Failure Analysis and Design
MMD 509.3 (PE | ST) Version: 1.0	Tribology in Design
MMD 509.4 (PE | ST) Version: 1.0	Engineering Fracture Mechanics
MMD 509.5 (PE | ST) Version: 1.0	Design for Manufacture and Assembly
MMD 509.6 (PE | ST) Version: 1.0	Reliability Engineering

Program Elective-II

Course Code	Course Title
MMD 510.1 (PE | ST) Version: 1.0	Vehicle Dynamics
MMD 510.2 (PE | ST) Version: 1.0	Design of Material Handling Equipment
MMD 510.3 (PE | ST) Version: 1.0	Advanced Finite Element Analysis
MMD 510.4 (PE | ST) Version: 1.0	Process Equipment Design
MMD 510.5 (PE | ST) Version: 1.0	Product Design & Development
MMD 510.6 (PE | ST) Version: 1.0	Robotics

MMD501:Research Methodology

Unit No.	**Contents**	Hrs
Unit 01	**Design of Experiments (DOE):** Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles- replication, randomization, blocking, Guidelines for design of experiments, process of DOE. **Simple Comparative Experiments** Basic statistical concepts, random variable, sample mean and variance, degrees of freedom, standard normal distribution, statistical hypothesis, Two sample *t*test, *P*-value, Confidence Intervals, Paired comparison.	06
Unit 02	**Single Factor Experiment**: Analysis of Variance (ANOVA) for fixed effect model; Total, treatment and error sums of squares, Decomposition of total sum of squares, ANOVA for Randomized complete block design to control effects of nuisance factors. **Two factor Factorial Design:** Basic definitions and principles, main effect and interaction, response surface and contour plots, Blocking, General arrangement for a two-factor factorial design; Models- Effects, means and regression	08
Unit 03	**Taguchi Techniques for Experimental Design**: Taguchi loss function, Average loss, nominal-the-best, smaller-the-best, larger-the-best, design process steps, selection of factors affecting- methods, factor levels, Test strategies- Full factorial experiment, fractional factorial experiment, Orthogonal arrays and their selection; Interaction effects, **Parameter Design**- Control and noise factors and parameter design, signal to noise ratio, types, parameter design strategy, tolerance design, robust design	05
Unit 04	**Research:** Definition of research, Applications of research and types, Research process and steps in it, Deductive and inductive reasoning; **Validity**-conclusion, internal, construct and external; Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.	05

MMD501:Research Methodology

Unit No.	**Contents**	Hrs
Unit 05	**Literature review:** Need, Procedure- Search for existing literature, Review the literature selected, Develop a theoretical and conceptual framework, Writing up the review. **Formulating a research problem:** Sources, Considerations, Steps in formulation of a problem, formulation of objectives. **Definition of variables:**Concepts, indicators and variables, Types of variables, Types of measurement scales. **Constructing the Hypothesis:**Null(Research) and alternative, one-tailed and two-tailed hypotheses, Hypothesis testing, errors in testing.	05
Unit 06	**Research Modeling**: Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling, Data collection methods, Surveys-types and method selection. **Research Proposal:** Contents-Preamble, the problem, objectives, hypothesis to be tested, study design, setup, measurement procedures, analysis of data, organization of report; Displaying data- tables, graphs and charts, **Writing a research report-** Developing an outline, Key elements- Introduction, Methods, Measurement section, Design & procedure section, Results, Conclusion section, Referencing of books and research papers, Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.	08

Academic Year 2018-19 **Syllabus Structure and Contents**

MMD503: Advanced Engineering Materials

Unit No.	Contents	Hrs
Unit 01	**Review of Engineering Materials-** Metals, alloys- ferrous & non-ferrous, plastics & polymers, ceramics and composites. Dual phase steels, micro alloyed steels, High strength low alloy steels,transformation inducted plasticity (TRIP) steels, Maraging steels. Heat treatment of ferrous and non-ferrous alloys for modification of structure and properties such as Al-Si alloy, 60-40 Brass.	06
Unit 02	**Modern materials-** Compositions, properties & applications of: Inter-metallics, Ni & Ti aluminides,smart materials, shape memory alloys, Metallic glass-quassi crystals, Dielectrics, semiconductors, conductors & super conducting materials. Magnetic & photoelectric materials, optical materials, Bio materials, micro electronic materials &nano-materials	06
Unit 03	**Non Metallic Materials** Polymer materials, formation of polymer structures, production techniques of fibers, foams, adhesives and coatings. Structure, properties and applications of engineering polymers. Advanced structural ceramics, WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN and diamondproperties, processing and applications.	08
Unit 04	**Composites** Fibers-glass, boron, carbon, organic, ceramic and metallic fibers-matrix materials polymers, metals and ceramics. Processing of polymer matrix composites: open mould process, bag molding, compression molding with BMC and SM- filament winding, pultrussion- centrifugal casting, injection molding, applications of PMC's.	08
Unit 05	**Processing of metal matrix polymers** Solid state fabrication techniques- diffusion bonding, powder metallurgy techniques, plasma spray, chemicaland physical vapor deposition of matrix on fibers, Liquid state fabrication methods, Infiltration,squeeze casting. Applications of MMC's.	06
Unit 06	**Selection of Materials** Motivation for selection, cost basis and service requirements- selection for mechanical properties, strength, toughness, fatigue and creep. Selection for surface durability,corrosion and wear resistance. Relationship between materials selection and processing. Case studies in material selection for different applications	06

MMD503:Advanced Engineering Materials

Term Work:

Minimum TEN assignments based on above topics

Sr. No. **Reference Books**

01 W.D.Callister: Materials Science and Engineering: An Introduction, Wiley
02 Charles J A, Crane F.A.A. & Furness J A G ,"Selection and use of Engineering Materials", (3 rd edition), Butterworth – Heinmann
03 Physical Metallurgy and Advanced Materials, Seventh edition, R. E. Smallman&Ngan, Elsevier
04 "Materials & Processes in Manufacturing", E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, (PHI)
05 "Design & Manufacturing of Composite Structures", Geoff Eckold (Jaico Publishing House)
06 "Manufacturing Processes for Engineering Materials", S. Kalpaljian& Steven R. Schmidt, (PearsonEducation)
07 Krishnan K.Chawla, "Composite Material Science and Engineering", Springer- Verlog,
08 Agarwal D &Brontman L.J., "Analysis & Performance of fibre composites", John Willey Publications
09 Mallik P.K. & Newman S.,"Composite Materials Technology", Henser Publications
10 "Materials and their applications", (4/e)- Jaico- 1999

MMD505:Advanced Solid Mechanics

Unit No.	Contents	Lecture Hrs
Unit 01	**Plane stress and plane strain** Differential equations of equilibrium, Boundary conditions, Compatibility, Stress functions and Bi-harmonic equation.	06
Unit 02	**Two dimensional problems in Rectangular coordinates** Applications to polynomials in rectangular coordinates, Saint-Venant's principle.	06
Unit 03	**Two dimensional problems in polar coordinates**: General equations in polar coordinates, Pure bending of curved bars, Strain components in polar coordinates, Rotating discs, stresses in circular discs.	08
Unit 04	**Shear center** Shear stress distribution and shear center for thin walled open sections. Bending of Beams, energy methods, Introduction to elastic stability, plasticity.	08
Unit 05	**Torsion** Torsion of bars with elliptical square and rectangular cross section Membrane analogy, Hydro dynamical analogy, Torsion of hollow and thin tubes.	06
Unit 06	**Membrane stresses in shell and storage vessels and Contact stresses**: Shells and vessels of uniform strength. Problem of determining contact stresses, Assumption Expressions for principalstresses, Examples.	06

MMD505:AdvancedSolid Mechanics

Sr. No.	**Term Work**- Assignments on
01	Plane stress and plane strain
02	Two dimensional problems in Rectangular coordinates
03	Two dimensional problems in polar coordinates:
04	Shear center
05	Torsion
06	Membrane stresses in shell and storage vessels
07	Contact stresses

Sr. No. **Text Books/ Reference Books**

01 Timoshenko, “Theory of Elasticity”, McGraw hill book Co.

02 Wang, “Applied Elasticity”, McGraw hill book Co.

03 J. Chakraborti, “Theory of Plasticity”, McGraw hill book Co.

04 Advanced Strength of Materials – Den Harteg

05 Sadd, Martin H., Elasticity: Theory, applications and Numeric, Academic Press 05 (Text Book)

06 Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons

07 Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/
McGraw Hill 1999

Academic Year 2018-19 **Syllabus Structure and Contents**

MMD507: Advanced Machine Design

Unit No.	Contents	Lecture Hrs
Unit 01	**Introduction** Statistical Considerations in Design for factor of safety, relationship between actual load and load capability, selection of factor of safety based on percentage estimates for tolerances on actual load and load capability and where the occurrence of the failure phenomenon would be disastrous.	06
Unit 02	**Optimum design** Optimum design for mechanical elements by considering adequate design, optimum design, P.D.E., S.D.E., limit equations, principles of optimum design with normal specifications, redundant specifications, incompatible specifications, optimum design of tensile bar, torsion shaft, beams, step shafts and with combined loading	06
Unit 03	**Mechanical springs** Design of square or rectangular bar helical springs, Belleville springs, ring springs, torsion bar springs, theory of square or rectangular bar helical springs under axial loading, cone or flat disc spring theory	08
Unit 04	**Cams** Basic curves, cam size determination, calculating cam profiles, advance curves, polydyne cams, dynamics of high speed cam systems, surface materials, stresses and accuracy, ramps.	08
Unit 05	**Flat plate** Stress resultants in a flat plate, kinematics strain- displacement, relations for plates, equilibrium equation for small displacement, theory of plates, stress-strain temperature relations for isotropic elastic plates, strain energy of a plate, boundary conditions for plates, Circular plates with hole and without hole with different types of support and loading.	06
Unit 06	**Advances in machine design** Defining design, creativity, invention and innovation, design methodology, patterns of evaluation, design patents, functional approach, performance specifications, Quality Function Deployment, improvement of ideality, design strategy, problem definition, objective, top down and bottom up approaches, system, problem formulation, substance field analysis, morphological analysis, creative problem solving, inventive principle, evaluation of ideas or concepts, product design specifications, selection of best design.	06

MMD507: Advanced Machine Design

Sr. No.	**Term Work- Assignments on**
01	Statistical Considerations in Design
02	Optimum design
03	Mechanical springs
04	Cams
05	Flat plate
06	Advances in machine design

Sr. No. **Text Books/ Reference Books**

01 Robert L. Norton, Machine Design: An Integrated Approach, Prentice-Hall New Jersey, USA.

02 George E Dieter, Engineering Design, McGraw Hill, 2008.

03 J.E. Shigley and L.D. Mitchell, Mechanical Engineering Design, McGraw Hill International Book Company, New Delhi

04 Hamrock, Schmid and Jacobian, Fundamentals of Machine Elements, 2nd edition, McGrawHill International edition.

05 Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, 6/e, Tata McGraw Hill.

06 A.K. Chitale and R.C. Gupta, Product Design and Manufacturing, Prentice Hall

MMD511: Measurements & Analysis Lab

The following experiments are to be performed in the laboratory

1. Measurements of mechanical parameters: a) Displacement b) Force c) Torque

2. Measurement of hydraulic parameters: a) Pressure b) vacuum c) Flow

3. Measurement of thermal parameters: Temperature: Industrial thermo couples, Resistance thermometer, Radiation temperature measurement.

4. Measurement of vibration parameter: a) Displacement -Vibrometer b) Velocity - Velocity pickup. c) Acceleration- Accelerometer d) Frequency –Vibration Analyzer

5. Measurement of Sound parameters (Noise Meter): a) Sound intensity level b) Sound Power level c) Sound Pressure level

6. Signal & system analysis

7. Condition monitoring and signature analysis applications: Vibration signature analysis of different existing machines such as Lathe, Grinder, Blower etc.

8. Data acquisition and conversion.

Sr. No.	**Text Books/ Reference Books**
01	B. C. Nakra& K. K. Choudhary, " Instrumentation, Measurement & Analysis" Tata McGraw Hill Publications Pvt. Ltd., New Delhi.
02	Rangan& Sharma, "Instrument Devices & Systems" Tata McGraw Hill Publications Pvt.Ltd., New Delhi.
03	Earnest O Doeblin, "Measurement Systems: Applications & Design", McGraw HillInternational.

Academic Year 2018-19**Syllabus Structure and Contents**

MMD513: CAD & Analysis Lab

Laboratory Experiments: Students are expected to develop 3D model and analyze the same for loaded configuration. Students will be given on experience on the software packages such as, ANSYS. Various Designs will be analyzed using ANSYS. Various manufacturing processes will be modeled and simulated and the effects of process variables on the quality of product will be analyzed.

1. Study of Finite Element Analysis and its different approaches.

2. Basic procedure of Finite Element Method and Mathematical formulation of problems.

3. Analysis of 1D structural members and verification of the same through manual calculation.

4. Beam analysis problems and their verification

5. Formulation of Dynamic problem and its solution for finding Eigen values and Eigen vectors

6. Problem formulation of 1D & 2D heat transfer problem and verifying solution using software

7. Finite Element Analysis of 2D, 3D problems(any one) using FEA: Gear tooth analysis,Crane Hook analysis, Pressure Vessel stress Analysis,Connecting Rod, Crank Shaft, Cam Shaft Stress Analysis.

8. Flow Simulation: Flow through pipes, flow over bodies.

9. At least one project and a case study should be carried out based on recent Publications / research papers / technical development.

Sr. No. **Text Books/ Reference Books**

01 Rao S. S. “Finite Elements Method in Engineering”- 4th Edition, Elsevier, 2006

02 Frank L. Stasa,” Applied finite Element Analysis for Engineers”, CBS International Edition, 1985.

03 Bathe K. J. Finite Elements Procedures, PHI. Cook R. D., et al. “Concepts and Application of
Finite Elements Analysis”- 4th Edition, Wiley & Sons, 2003.

04 Zeinkovich, “The Finite Element Method for Solid and Structural Mechanics, 6th Ed.,Elsevier 2007.

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MMD515: Seminar - I

(i) Students shall carryout an exhaustive literature review(research articles, technical articles, white papers, books etc.), on a chosen topic under the supervision of a Guide and present the findings in the form of a review paper in the department in front of a departmental faculty committee, as a part of the term work / POE.

(ii) The article must be published in a National / International Conference/Journal as a part of the term work / POE.

MMD502: Analysis and Synthesis of Mechanisms

Unit No.	Contents	Lecture Hrs
Unit 01	**Basic concepts** Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.	06
Unit 02	**Curvature theory** Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.	06
Unit 03	**Kinematic synthesis of planar mechanisms-graphical** accuracy (precision) points, Chebyshev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, center and circle point curves,	08
Unit 04	Kinematic synthesis of planar mechanisms – analytical Analytical synthesis of four-bar and slider-crank mechanisms, Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.	08
Unit 05	**Coupler curves** Equation of coupler curve, Robert-Chebyshev theorem, double points and symmetry.	06
Unit 06	**Kinematic analysis of spatial mechanisms** Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms	06

MMD502: Analysis and Synthesis of Mechanisms

Sr. No.	**Term Work**
01	Assignments on planar and spatial mechanisms
02	Curvature theory
03	Kinematic synthesis of planar mechanisms-graphical
04	Kinematic synthesis of planar mechanisms – analytical
05	Coupler curves
06	Kinematic analysis of spatial mechanisms

Sr. No. **Text Books/ Reference Books**

01 R.S. Hartenberg and J. Denavit, “Kinematic Synthesis of Linkages”, McGraw-Hill, New York, 1980.

02 Robert L. Nortan ,"Design of Machinery', Tata McGraw Hill Edition

03 Hamilton H. Mabie, "Mechanisms and Dynamics of Machinery", John Wiley and sons New York

04 S. B. Tuttle, "Mechanisms for Engineering Design" John Wiley and sons New York

05 A. Ghosh and A.K. Mallik, “Theory of Machines and Mechanisms”, Affiliated East-West Press, New Delhi, 1988.

06 A.G. Erdman and G.N. Sandor, “Mechanism Design – Analysis and Synthesis”, (Vol. 1 and 2), Prentice Hall India, 1988.

07 A.S. Hall, “Kinematics and Linkage Design”, Prentice Hall of India

MMD504: Design Optimization

Unit No.	Contents	Lecture Hrs
Unit 01	**Introduction** Optimal problem formulation, engineering optimization problems, optimization algorithms. Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimization techniques.	06
Unit 02	**Multivariable optimization algorithms** Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.	06
Unit 03	**Constrained optimization algorithms** Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.	08
Unit 04	**Special optimization algorithms** Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods	08
Unit 05	**Optimization in operations research:** Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis	06
Unit 06	**Stochastic programming** Basic concepts of probability theory, random variables Distributions – mean, variance, Correlation, co variance, joint probability distribution stochastic linear, dynamic programming.	06

MMD504: Design Optimization

Sr. No.	**Term Work**- Assignments on
01	Engineering optimization problems
02	Multivariable optimization algorithms
03	Constrained optimization algorithms
04	Special optimization algorithms
05	Optimization in operations research:
06	Stochastic programming

Sr. No.	**Text Books/ Reference Books**
01	Deb Kalyanmoy, "Optimization in Engineering Design", PHI, New Delhi
02	Rao S. S. "Engineering Optimization", John Wiley, New Delhi.
03	Deb Kalyanmoy, "Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
04	Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press, UK
05	Chandrupatla, "Optimization in Design", PHI, New Delhi

MMD506: Advanced Machine Tool Design

Unit No.	Contents	Lecture Hrs
Unit 01	**Introduction** Classification of machine Tools, Elements of machine tools, selection of speed and feed, various types of clutch systems, tool drives and mechanism, general requirements of machine tool design process as applied to machine tools, layout of machine tool, various motions introduced in machine tools, parameters defining limits of motions. Requirements of machine, tools drives, mechanical and hydraulics transmission used in machine drives their element	06
Unit 02	**Design of machine tool structure** Function of machine tool structure and their requirements. Design criteria, materials, Strength and Rigidity consideration, process capability and compliance, static and dynamic stiffness, basic design procedure, design items like beam, column, housing, rams, etc.	06
Unit 03	**Design of guide ways and power screws** Function and types of guide ways, design of slide ways, force analysis of Lathe guide ways, design of antifriction guide ways, design of power screws	08
Unit 04	**Design of Spindle and spindle support** Function of spindle unit requirement, material of spindles, design calculations design of antifriction bearings, sliding bearing used for spindles	08
Unit 05	**Dynamics of machine Tools** Vibration of machine tools and dynamic rigidity: Effect of vibrations, source of\ vibrations, self-excited vibration, single degree of freedom chatter, velocity principle and related models, regenerative principles, chatter in lathe, drilling, milling & grinding, machine tool elastic system, general procedure for assessing, Dynamic stability of equivalent elastic system.	06
Unit 06	**Automation** Automation drives for machine tools, Degree of automation, Semi automation, analysis of collect action, design of collect, bar feeding mechanism, tooling layout, single spindle mechanism, analysis, swiss type automatic machine. Loading and unloading. Transfer- devices, Modulator- design concept, in process gauging.	06

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD506: Advanced Machine Tool Design

Term Work:

Minimum TEN assignments based on above topics

Sr. No.	**Reference Books**
01	Machine tool design – N. K. Mehta, 1984, Tata McGraw Hill Publishing Co. Ltd.
02	Principles of Machine tool – G. C. Sen and A. Bhattacharyya, New Central book agency, Calcutta.
03	Design of machine tool – S. K. Basu, Allied Publishers Bombay.
04	Design principles of metal cutting machine tools – F. Koeniga Berger
05	Machine tools design by Mehta: Tata McGraw Hill
06	Principles of machine tools by Sen et al Central Book Agency
07	Machine Tool Design by Bassu& Pal: Oxford & IBH
08	Machine tool Design vol. i to iv by Acherken: Mir Publishers
09	Design Principles of Metal cutting machine tools: Koenigsberger,Pergamon

MMD508: Noise, Vibration and Harshness

Unit No.	Contents	Lecture Hrs
Unit 01	**Multi-degree of freedom system** Free Vibration Equation of motion, Influence Coefficients (Stiffness and Flexibility), Generalized Coordinates, and Coordinate Coupling. Lagrangian and Hamilton Equations, Matrix Method, Eigen value and Eigen Vector Method	06
Unit 02	**Vibration measurement** Basic signal attributes, Vibration measuring sensors (Displacement, Velocity, and Acceleration), Piezoelectric Accelerometers, Method for Calibrating Accelerometer, Basic Process of Digital Frequency Analyzer, Digital Analyzer operating principles, Measurement of phase, Phase fundamentals, Comparing two waveforms using reference, Cross Channel phase analysis, Electronic Filters, Time and orbital domain, Time and frequency domains, Evaluation of vibration severity, ISO standards: ISO 10816 and ISO 7919	06
Unit 03	**Modal analysis** Introduction, Free vibration response using modal analysis, Forced vibration response using modal analysis, Experimental modal analysis: Necessary equipment, signal processing, Measurement of mode shapes, Introduction to damage detection in structures using changes in modal frequency and mode shapes	08
Unit 04	**Vibration control** Conventional Methods: By Mass/Inertia, Stiffness, Damping (Vibration Isolation Principles). Dynamic vibration absorbers. Introduction to Semi-Active and Active Vibration Control	08
Unit 05	**Non-linear vibrations** Basics of non-linear vibration, Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phaseplane techniques, Duffing's equation, Jump phenomenon, Limit cycle, Perturbation method.	06
Unit 06	**Vibration analysis for machinery malfunction** Analysis of machinery vibration problems, Methodology of vibration analysis, Condition/vibration monitoring data collection, Trending of data, Time wave form analysis, Signature analysis, Absolute Phase analysis and cross channel phase analysis, Orbit analysis. Root Cause Analysis. Methodology 12 of diagnosis of unbalance, misalignment and antifriction bearing defects. Frequency calculation and their significance in signature analysis of antifriction bearing, Mechanical Looseness, diagnosis of foundation problem.	06

MMD508: Noise, Vibration and Harshness

Sr. No. **Term Work**

Assignments on

01 Two assignment on multi-degree of freedom system

02 Two assignment on vibration measurement

03 Two assignment on modal analysis

04 Vibration control

05 Non-linear vibrations

06 Two assignment on vibration analysis for machinery malfunction

Sr. No. **Text Books/ Reference Books**

01 Leonard Meirovitch – Elements of Vibration Analysis, McGraw Hill.

02 Thomson W.T, Theory of Vibration with Applications, Prentice Hall India.

03 Rao V and J Srinivas, Mechanical Vibrations, PHI Learning Pvt. Ltd.

04 S.S.Rao, Mechanical Vibrations, Pearson Education India

Academic Year 2018-19 **Syllabus Structure and Contents**

MMD512: Analysis & Synthesis Lab

The term work comprises of assignments on the following topics.
1. Complex Mechanism Analysis.
2. Dynamic Analysis.
3. Graphical and Analytical Synthesis.
4. Curvature Theory.

Use of software such as 'ADAMS' and 'Working Model' is recommended

Sr. No.	**Reference Books**
01	R.S. Hartenberg and J. Denavit, “Kinematic Synthesis of Linkages”, McGraw-Hill, New York, 1980.
02	Robert L. Nortan ,"Design of Machinery', Tata McGraw Hill Edition
03	Hamilton H. Mabie, "Mechanisms and Dynamics of Machinery", John Wiley and sons New York
04	S. B. Tuttle, "Mechanisms for Engineering Design" John Wiley and sons New York
05	A. Ghosh and A.K. Mallik, “Theory of Machines and Mechanisms”, Affiliated East-West Press, New Delhi, 1988.
06	A.S. Hall, “Kinematics and Linkage Design”, Prentice Hall of India.
07	J.E. Shigley and J.J. Uicker, “Theory of Machines and Mechanisms”, 2nd Edition, McGraw-Hill, 1995.

Academic Year 2018-19 **Syllabus Structure and Contents**

MMD514: Noise, Vibration and Harshness Lab

1. Experiment on damped vibration
2. Torsional vibration analysis
3. Experiment based on failure analysis of mechanical component.
4. Design of mechatronic system for mechanical application
5. Modal analysis of cantilever beam
6. Design and modelling of mechanical component using commercial software
7. Stress Analysis of composite shaft
8. Modal analysis of composite shaft

Sr. No. **Text Books/ Reference Books**

01 Rao, J.S. & Gupta K., "Ind. Course on Theory and Practice Mechanical Vibration", New AgeInternational (P) Ltd., 1984.
02 Thomson, W.T., "Theory of Vibration with Applications" CBS Publishers and Distributors, NewDelhi ,1990
03 Zeinkovich, "The Finite Element Method for Solid and Structural Mechanics, 6th Ed.,
Elsevier 2007

04 Bathe K. J. Finite Elements Procedures, PHI. Cook R. D., et al. "Concepts and Application ofFinite Elements Analysis"- 4th Edition, Wiley & Sons, 2003.
05 Bolton W, Mechatronics-Electronics Control Systems in Mechanical and Electrical Engg.

MMD516: Seminar - II

(i) Students shall carryout an exhaustive literature review (research articles, technical articles, white papers, books etc.), on a chosen topic under the supervision of a Guide and present the findings in the form of a review paper in the department in front of a departmental faculty committee as a part of the term work / POE.

Alternatively results of an experimental work for the purpose of research carried out under the supervision of a Guide may be presented in the same manner.

(ii) The article must be published in a National / International Conference/Journal as a part of the term workas a part of the term work / POE.

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.1: Experimental Stress Analysis

Unit No.	Contents	Lecture Hrs
Unit 01	**Photo Elasticity** Arrangement of optical elements in a polar scope , Theory of photo elasticity ,Plane & circular polariscope, Isoclinics and isochromatics Model Materials:Properties , selection and method of calibration. Different methods of analysis:Compensation technique, principle stresses separation technique, calibration methods fringe Multiplication, scaling model to prototype, Application of photo elasticity for two dimensional models.	06
Unit 02	**Three Dimensional Photo elasticity** Stress locking in model materials, slicing technique, shear difference method. Scattered light photo elasticity, Dynamic photo elasticity.	06
Unit 03	**Strain Gauges** Electrical Resistance strain gauges : types ,gauge factor , sensitivity ,applications. Materials ,Bonding of strain gauges : surface preparation ,moisture proofing etc. ,types of bonds, Testing of gauge installations, Strain measuring circuits, commercial strain indicators, Rosette Analysis, Strain gauge transducers, Cross sensitivity , Temperature compensation, Semi –Conductor strain gauges.	08
Unit 04	**Coating Methods for stress analysis** Coating stresses, Birefringent coatings (Photoelastic& Brittle coatings), coating sensitivity, coating materials, analysis of brittle- coating data.	08
Unit 05	**Holography** Equation for plane waves and spherical waves Intensity – Coherence – Sphericalradiator as an object (record process) Hurter – Driffeld curve reconstruction process General case, Holographic set up	06
Unit 06	**Moire technique** Geometrical approach – sensitivity of Moire data - data reduction in plane and outplaneMoire methods – Moire photography – Moire grid production.	06

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Program Elective-I

MMD509.2: Experimental Stress Analysis

Sr. No.	**Term Work**
01	Demonstration of preparation of 2D photoelastic model.
02	Demonstration of preparation of 3D photoelastic model.
03	Demonstration of stress freezing technique.
04	Demonstration of calibration technique of photoelastic material.
05	Evaluation of stresses in photoelastic model by using polar scope.
06	Demonstration of stress analysis technique by using brittle coating technique.
07	Demonstration of stress measurement by using strain gauge rosette.

Sr. No. **Text Books/ Reference Books**

01 Dally and Riley, “Experimental Stress Analysis”. McGraw Hill.
02 Srinath, Lingaiah, Raghavan, Gargesa, Ramachandra and Pant, “Experimental Stress Analysis”. Tata McGraw Hill.
03 Sadhu Singh “Experimental Stress Analysis”. Hanna publisher.
04 Hand Book of Experimental Stress Analysis by Hyteneyi.
05 M. M. Frocht, “Photo elasticity Vol I and Vol II. John Wiley & sons.
06 Perry and Lissner, “Strain Gauge Primer”.
07 Kuske, Albrecht & Robertson “Photo elastic Stress analysis” John Wiley & Sons.

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.2: Failure Analysis and Design

Unit No.	Contents	Lecture Hrs
Unit 01	**Theories of failure** Maximum shear stress theory, Maximum normal stress theory, Maximum distortion energy theory, Maximum strain theory, Applicability of theories of failure.	06
Unit 02	**Fracture** Type of fracture, Theoretical cohesive strength of metals, Griffith theory of brittle fracture, fracture single crystals, Metallographic aspects of fracture, Dislocation theories of brittle fracture, Ductile fracture, Notch effects, Fracture under combined stresses.	06
Unit 03	**Elements of fracture mechanics & fatigue failure** Strain- energy release rate, Stress intensity factor, Fracture toughness, Plane - strain toughness testing, Crack-opening displacement, J- Integral to solve energy of crack formation, R-curves, Toughness of material. Stress cycle, S-N curve, Description of fatigue fractured parts, Phases of fatigue fracture, Fatigue crack propagation, Effects of metallurgical variables, Temperature, Stress concentration, Size and surface factors, Fatigue under combined stresses.	08
Unit 04	**Creep failure & brittle fracture** Creep curve, Structural changes and mechanisms during creep, Activation energy for steady-state creep, Fracture at elevated temperature. Transition temperature curves, Fracture analysis diagrams, Various types of embitterment, Fracture under very rapid loading.	08
Unit 05	**Ductile fracture** Condition for necking, Dislocation and void formation activities, Types of fractured parts. Assessment of types of fractures by observation: Comparison between different fractured parts undergoing various type of fracture.	06
Unit 06	**Design application of the knowledge of failure** Design considering fatigue-Geber's parabola, Soderberg equation, lubricating optimally to combat bearing failures. Selection of materials to prevent seizure, galling, etc. Wear reduction techniques, Fracture toughness consideration in design.	06

Program Elective-I

MMD509.2: Failure Analysis and Design

Sr. No.	**Term Work -** Assignments on
01	Theories of failure
02	Fracture
03	Elements of fracture mechanics & fatigue failure
04	Creep failure & brittle fracture
05	Ductile fracture
06	Design application of the knowledge of failure

Sr. No. **Reference Books**

01 Madoyag, F., Metal Fatigue Design and Theory.
02 Sors, L., Fatigue Design of Machine Components, Pergamon Press.
03 Rolfe, S.T. and Barson, J.M., Fracture and Fatigue Control Structures, Prentice Hall.
04 Broek, D., Elementary Engineering Fracture Mechanics, Noordnoff.

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.3: Tribology in Design

Unit No.	Contents	Lecture Hrs
Unit 01	**Surfaces, friction and wear** Topography of Surfaces, Surface features, Surface interaction, Theory of Friction, Sliding and Rolling Friction, Friction properties of metallic and non -metallic materials, Friction in extreme conditions, Wear, types of wear, Mechanism of wear, wear resistance materials, Surface treatment, Surface modifications, Surface coatings.	06
Unit 02	**Lubrication theory** Lubricants and their physical properties lubricants standards, Lubrication Regimes in Hydrodynamic lubrication, Reynolds Equation, Thermal, inertia and turbulent effects.	06
Unit 03	Other types of lubrication Electro-hydrodynamic (EHD), Magneto hydrodynamic lubrication, Hydro static lubrication, Gas lubrication, Solid lubrication.	08
Unit 04	**Design of fluid film bearings** Design and performance analysis of thrust and journal bearings, Full, Partial, Fixed and pivoted journal bearings design, Lubricant flow and delivery, Power loss, Heat and temperature of steady and dynamically loaded journal bearings, Special bearings, Hydrostatic Bearing design.	08
Unit 05	**Rolling element bearings** Geometry and kinematics, Materials and manufacturing processes, Contact stresses, Hertzian stress equation, Load divisions, Stresses and deflection, Axial loads and rotational effects, Bearing life capacity and variable loads, ISO standards, Oil films and their effects, Rolling Bearings Failures.	06
Unit 06	**Tribo measurement and instrumentation** Surface Topography measurements, Electron microscope and friction and wear measurements, Laser method, Instrumentation, International standards, Bearings performance measurements, bearing vibration measurement	06

Program Elective-I

MMD509.3: Tribology in Design

Term Work:
Minimum TEN assignments based on above topics

Sr. No. **Reference Books**

01 Cameron A., "Basic Lubrication Theory", Ellis Horwood Ltd., UK, 1981
02 Halling J. (Editor) – "Principles of Tribology ", Macmillian, 1984.
03 Williams J.A., "Engineering Tribology", Oxford Univ. Press, 1994.
04 Neale, M.J., "Tribology Hand Book", Butterworth Heinemann, 1995.
05 StolarskiT. A., "Tribology in Machine Design", Industrial Press Inc., 1990.

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.4: Engineering Fracture Mechanics

Unit No.	**Contents**	Lecture Hrs
Unit 01	**Introduction** Macroscopic failure mode, ideal fracture strength, energy release rate, Fracture Modes	06
Unit 02	**Fracture criteria** Griffith criterion, Irwin's Fracture Criterion, Stress Intensity Approach, Stress intensity factor, crack tip plasticity, crack opening displacement, plastic constraint	06
Unit 03	**Methods for evaluating fracture toughness** Numerical Methods: - Finite Elements (FE), Finite Differences (FD), Boundary Integral Equations (BIE) Experimental Methods: - Compliance Method, Photo-elasticity. Interferometry and Holography	08
Unit 04	**Experimental evaluation of fracture toughness:** Plane strain fracture toughness, J– Integral	08
Unit 05	**Fatigue mechanics** S-N diagram, fatigue limit, fatigue crack growth rate, Paris law.	06
Unit 06	**Creep mechanics** Creep deformation, creep strength, creep-fatigue interaction	06

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.4: Engineering Fracture Mechanics

Term Work:
Minimum TEN assignments based on above topics

Sr. No. **Reference Books**

01 Fundamentals of Fracture Mechanics, T. Kundu, Pub. CRC Press (Taylor and Francis), 2008, ISBN 0-8493-8432-5
02 T. Anderson, Fracture Mechanics, CRC Pub
03 D. Broek, Elementary Engineering Fracture Mechanics, 4/e Revised, Kluwer Academic Pub., 1991, ISBN 90-247-2656-5.
04 K. Hellan, Introduction to Fracture Mechanics, McGraw-Hill, 1984.
05 G. Sih, Handbook of Stress Intensity Factors.
06 Timoshenko, S.P. and J.N. Goodier, "Theory of Elasticity", McGraw Hill (1970).
07 Broek, D., "Elementary Engineering Fracture Mechanics", 4/e, MartinusNijhoff(1987).
08 Maiti S. K., Fracture Mechanics: Fundamentals and Applications,Cambridge University Press, 2015.

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.5: Design for Manufacture and Assembly

Unit No.	**Contents**	Lecture Hrs
Unit 01	**Introduction to tolerances:** Tolerances: Limits and Fits, tolerance Chains and identification of Functionally important dimensions. Dimensional chain analysis-equivalent tolerances method, equivalent standard tolerance grade method, equivalent influence method. Geometric tolerances: applications, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard, surface finish, review of relationship between attainable tolerance grades and different machining	06
Unit 02	**Form design of castings, weldments, forging and sheet metal components:** Materials choice - Influences of materials - Space factor - Size - Weight - Surface properties and production method on form design. Redesign of castings based on parting line considerations, Minimizing core requirements, redesigning cast members using Weldments, form design aspects in Forging and sheet metal components.	06
Unit 03	**Component Design** Machining Considerations Design features to facilitate machining - Drills - Milling cutters - Keyways - Doweling procedures, Counter sunk screws - Reduction of machined area - Simplification by separation - Simplification by amalgamation - Design for machinability – Design or economy - Design for clampability - Design for accessibility - Design for assembly.	08
Unit 04	**Redesign For Manufacture** Design features to facilitate machining: datum features - functional and manufacturing. Component design – machining considerations, redesign for manufacture, examples.	06
Unit 05	**DFMA TOOLS:** Rules and methodologies used to design components for manual, automatic and flexible assembly, traditional design and manufacture Vs concurrent engineering, DFA index, Pokayoke, lean principles, six sigma concepts, DFMA as the tool for concurrent engineering, three DFMA criteria for retaining components for redesign	06

	of a product; design for manual assembly; design forautomatic assembly; computer-aided design for assembly using software.	
Unit 06	**Design for the environment:** Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for Recyclability – Design for remanufacture –Design for energy efficiency – Design to regulations and standards.	08

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.5: Design for Manufacture and Assembly

Term Work:
Minimum TEN assignments based on above topics

Sr. No. Reference Books

01 Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2/e
02 Harry Peck, "Design for Manufacture", Pittman Publication 1983.
03 Robert Matousek, "Engineering Design – A systematic approach", Blackie &Sons Ltd., 1963.
04 James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Co., 1986

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-I

MMD509.6: Reliability Engineering

Unit No.	Contents	Hrs
Unit 01	**Introduction** Brief history, concepts, terms and definitions, applications, the life cycle of a system, concept of failure, typical engineering failures and their causes, theory of probability and reliability, rules of probability, random variables, discrete and continuous probability distributions.	06
Unit 02	**Failure Data Analysis** Data collection and empirical methods, estimation of performance measures for ungrouped compete data, grouped complete data, analysis of censored data, fitting probability distributions graphically (Exponential and Weibull) and estimation of distribution parameters.	06
Unit 03	**Reliability Measures** Reliability function–R(t), cumulative distribution function (CDF)–F(t), probability density function (PDF) – f(t), hazard rate function-λ(t), Mean time to failure (MTTF) and Mean time between failures (MTBF), median time to failure (tmed), mode (tmode), variance (σ2) and standard deviation (σ), typical forms of hazard rate function, bathtub curve and conditional reliability.	08
Unit 04	**Basic Reliability Models** Constant failure rate (CFR) model, failure modes, renewal and Poisson process, two parameter exponential distribution, redundancy with CFR model, time-dependent failure models, Weibull, Rayleigh, Normal and Lognormal distributions, burn-in screening for Weibull, redundancy, three parameter Weibull, calculation of R(t), F(t), f(t), λ(t), MTTF, tmed, tmode, σ2 andσ for above distributions.Reliability Evaluation of Systems: Reliability block diagram, series configuration, parallelconfiguration, mixed configurations, redundant systems, high level versus low level redundancy, kout-of-n redundancy, complex configurations, network reduction and decomposition methods, cut andtie set approach for reliability evaluation.	08
Unit 05	**Maintainability and Availability** Concept of maintainability, measures of maintainability, mean time to repair (MTTR), analysis of downtime, repair time distributions, stochastic point processes, maintenance concept and procedures, availability concepts and definitions, important availability measures.	06
Unit 06	**Design for Reliability and Maintainability** Reliability design process and design methods,reliability allocation, failure modes, effects and criticality analysis (FMECA), fault tree and success tree methods, symbols used, maintainability design process, quantifiable measures of maintainability, repair versus replacement. Reliability Testing: Product testing, reliability life testing, burn-in testing, acceptance testing,accelerated life testing and reliability growth testing.	06

MMD509.6: Reliability Engineering

Term Work:

Minimum TEN assignments based on above topics

Sr. No. **Reference Books**

01 Charles E. Ebling, 2004, An Introduction to Reliability and Maintainability Engineering, TataMcGraw Hill Education Private Limited, New Delhi.
02 L. S. Srinath, 1991, "Reliability Engineering", East West Press, New Delhi.
03 Alessandro Birolini, 2010, "Reliability Engineering: Theory and Practice", Springer.
04 Guangbin Yang, 2007, "Life cycle reliability engineering", John Wiley and Sons.
05 Roy Billiton and Ronald Norman Allan, 1992, "Reliability evaluation of engineering systems:concepts and techniques", Springer.
06 Patrick D.T. O'Conner, David Newton, Richard Bromley, 2002, "Practical Reliability Engineering", John Wiley and Sons.
07 W. R. Blischke, D.N.P. Murthy, 2003, "Case studies in Reliability and Maintenance", John Wiley and Sons.
08 Andrew Kennedy, Skilling Jardine, Albert H. C. Tsang, 2006, "Maintenance, Replacement and Reliability: Theory and Applications", CRC/Taylor and Francis.
09 Joel A. Nachlas, 2005, "Reliability Engineering: Probabilistic Models and Maintenance Methods" Taylor and Francis.
10 B. S. Dhillon, Chanan Singh, 1981, Engineering Reliability – New Techniques and Applications",John Wiley and Sons.

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-II

MMD510.1: Vehicle Dynamics

Unit No.	Contents	Lecture Hrs
Unit 01	**Introduction** Classification of vibration, definitions, mechanical, vibrating systems, mechanical vibration and human comfort, modeling and simulation studies. Model of an automobile, one degree of freedom, two degree of freedom systems, free, forced and damped vibrations. Magnification and transmissibility. Vibration absorber, multi-degree of freedom systems-closed and far coupled systems, Orthogonality of modal shapes, modal analysis.	06
Unit 02	**Suspension** Requirements, spring mass frequency, wheel hop, wheel shimmy, choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces.	06
Unit 03	**Steering systems** Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering	08
Unit 04	**Stability of vehicles** Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, overturning and sliding. Rigid vehicle-stability and equations of motion. Cross wind handling.	08
Unit 05	**Tyres** Types. Relative merits and demerits. Ride characteristics. Behavior while cornering, slip angle, corneringforce, power consumed by a tyre. Effect of camber, camber thrust.	06
Unit 06	**Vehicle Handling** Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering, effect of camber, transient effects in cornering. Directional stability of vehicles.	06

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-II

MMD510.1: Vehicle Dynamics

Term Work:

Minimum TEN assignments based on the topics mentioned below.

1. Analysis of different Vehicle Models subjected various types of excitations in i. Time Domain and ii. Frequency domain using "C" programs or MATLAB
2. Testing of vehicle Ride comfort using FFT analyzer.
3. Testing of Vehicle stability using different models and excitations.
4. Calculation of drag force and its effect on the stability on the vehicle.

Sr. No. **Reference Books**

01 Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992.
02 Thomson WT 'Theory of Vibration with Applications', CBS Publishers and Distributors, New Delhi.1990.
03 Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.
04 Cole D E, "Elementary Vehicle Dynamics", Ann Arbor, Michigan, USA, 1972.
05 Maurice Olley, "Chassis Design – Principles and Analysis", Bentley publishers.
06 J. G. Giles, 'Steering Suspension and Tyres, Illiffe Books Ltd., 1968.

Program Elective-II

MMD510.2: Design of Material Handling Equipment

Unit No.	Contents	Lecture Hrs
Unit 01	**Elements of material handling system:** Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other organizational functions; Classification of Material Handling Equipment's.	06
Unit 02	**Selection of material handling equipment's:** Factors affecting for selection; Material Handling Equation; Choices of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.	06
Unit 03	**Design of mechanical handling equipment's** Design of Hoists: Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms. Design of Cranes: Hand-propelled and electrically driven E.O.T. overheat Traveling cranes; Travelling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary rotary and travelling rotary cranes.	08
Unit 04	**Design of load lifting attachments** Load chains and types of ropes used in Material Handling System; Forged, Standard and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments.	08
Unit 05	**Study of systems and equipment used for material storage** Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc.	06
Unit 06	**Material handling / warehouse automation and safety considerations** Storage and warehouse planning and design; computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; which function, When and How to automate; Levels and Means of Mechanizations, Safety and design; Safety regulations and discipline.	06

Academic Year 2018-19 **Syllabus Structure and Contents**

Program Elective-II

MMD510.2: Design of Material Handling Equipment

Sr. No.	**Term Work** Assignments on
01	Elements of material handling system
02	Selection of material handling equipment's:
03	Design of mechanical handling equipment's
04	Design of load lifting attachments
05	Study of systems and equipment used for material storage
06	Material handling / warehouse automation and safety considerations

Sr. No. **Text Books/ Reference Books**

01 N. Rudenko, 'Material Handling Equipment', Peace Publishers, Moscow.

02 James M. Apple, 'Material Handling System Design', John Wiley and Sons Publication, NewYork.

03 John R. Immer, 'Material Handling' McGrawHill Co. Ltd., New York.

04 Colin Hardi, 'Material Handling in Machine Shops', Machinery Publication Co. Ltd., Landon.

05 Spivakovsy, A.O. and Dyachkov, V.K., 'Conveying Machines', Volumes I and II, MIR Publishers, 1985.

06 M .P. Nexandrn, 'Material Handling Equipment', MIR Publication, Moscow.

07 C. R. Cock and J. Mason, 'Bulk Solid Handling', Leonard Hill Publication Co. Ltd., U.S.A.

08 Kulwiac R. A., 'Material Handling Hand Book', 2/e, JohnWilly Publication. New York.

Program Elective-II

MMD510.3: Advanced Finite Element Analysis

Unit No.	Contents	Lecture Hrs
Unit 01	**Introduction to Finite Element Method :**	06
	Engineering Analysis, History, Advantages, Classification, Basic steps, Convergence criteria, Role of finite element analysis in computer-aided design., Mathematical Preliminaries, Differential equations formulations, Variational formulations, weighted residual methods.	
Unit 02	**One-Dimensional Elements-Analysis of Bars and Trusses and Two-Dimensional Elements-Analysis of Plane Elasticity Problems:**	06
	Basic Equations and Potential Energy Functional, 1-D Bar Element, trusses, Admissible displacement function, Strain matrix, Stress recovery, Element equations, Stiffness matrix, Consistent nodal force vector: Body force, Initial strain, Assembly Procedure, Boundary and Constraint Conditions, Single point constraint, Multi-point constraint, 2-D Bar Element, Shape Functions for Higher Order Elements.Three-Noded Triangular Element (TRIA 3), Four-Noded Quadrilateral Element (QUAD 4), Shape functions for Higher Order Elements (TRIA 6, QUAD 8).	
Unit 03	**Axi-symmetric Solid Elements and Three-Dimensional Elements**	08
	Analysis of Bodies of Revolution under axi-symmetric loading: Axisymmetric Triangular and Quadrilateral Ring Elements. Shape functions for Higher Order Elements. Applications to Solid Mechanics Problems: Basic Equations and Potential Energy Functional, Four- Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family. Shape functions for Higher Order Elements Analysis of Beams and Frames: 1–D Beam Element, 2–D Beam Element, Problems, plate bending and shell elements.	
Unit 04	**Heat Transfer and Fluid Flow:**	08
	Steady state heat transfer, 1 D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1 D heat transfer in thin fins. Basic differential equation for fluid flow in pipes, around solid bodies, porous media.	
Unit 05	**Dynamic Considerations:**	06
	Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix, Evaluation of Eigen values and Eigen vectors, Applications to bars, stepped barsand beams. Introduction to FE Software Packages, Algorithmic approach for developing the code by the individuals	
Unit 06	**Non-linear Analysis** Sources and types of non-linearity, Incremental approach to solution of nonlinear problems, Iterative solution methodologies, Considerations for simulation of non-linear problems	06

MMD510.3: Advanced Finite Element Analysis

Sr. No.	**Term Work**
	Assignments on
01	1D & 2D structural analysis.
02	Analysis of plane trusses
03	Stress Analysis of Bracket.
04	Stress Analysis of with circular hole
05	1D and 2D heat transfer problems.
06	Computation of shape function.
07	Analysis of 2-D transient heat flow in plate
08	Computer programs for 3D structural analysis
09	Finite Element Analysis of Fluid Flow Problems.
10	Formulation and solution of dynamic problems using computer programs.

Sr. No. **Text Books/ Reference Books**

01 Rao S. S. “Finite Elements Method in Engineering”- 4/e, Elsevier, 2006
02 Frank L. Stasa,” Applied finite Element Analysis for Engineers”, CBS International Edition, 1985.
03 J.N.Reddy, “Finite Element Method”- McGraw -Hill International Edition.
04 Bathe K. J. Finite Elements Procedures, PHI. Cook R. D., et al. “Concepts and Application of Finite Elements Analysis”- 4th Edition, Wiley & Sons, 2003.
05 Chandrupatla T. R., “Finite Elements in engineering”- 2nd Editions, PHI, 2007.2.
06 Zeinkovich, “The Finite Element Method for Solid and Structural Mechanics, 6/e, Ed., Elsevier 2007.

MMD510.4: Process Equipment Design

Unit No.	Contents	Lecture Hrs
Unit 01	**Design considerations for pressure vessel** Introduction; Selection of type of vessel, Methods of fabrication, Effect of fabrication methods, Various criteria in vessel design, Economic considerations, Types of process equipment, Constructional requirement and applications., Fabrication and testing, Inspection and non-destructive testing of equipment.	06
Unit 02	**Storage vessel** Design methods of atmospheric storage vessel: storage of fluids, storage of non-volatile liquids, storage of volatile liquids, storage of gases, Optimum tank proportion, Bottom design, Shell design, Wind girder for open top tank, Rub curb angle, Self supported roof, Design of rectangular tank.	06
Unit 03	**Pressure vessel** Unfired process vessel with internal and external pressure, Operating condition, Selection of material, Design condition, Stresses, Design criteria, Design of shell subjected to internal and external pressure, Cylindrical vessel under combined loading, Design of heads and closures: flat head and formed heads for vessel. Design consideration for rectors and chemical process vessels. Flange facings, Gaskets, Design of flanged joint, Flange thickness, and Blind flanges.	08
Unit 04	**High pressure vessel** Design of thick walled high-pressure vessel, Constructional features, Materials for high-pressure vessels, Multilayer vessel with shrink fit construction, Thermal expansion for shrink fitting, stress in multishell or shrink fit construction, autofrettage, Pre-stressing. Tall vessels and their design, Stress in shell, Determinations of longitudinal stresses, Longitudinal bending stresses due to eccentric loads, Determination of resultant longitudinal stresses.	08
Unit 05	**Agitated vessel** Type of agitators, Baffling, Power requirement for agitation, Design based on torque and bending moment, Design based on critical speed, Blade design, Hub and key design, Stuffing box and gland design, Turbine agitator design	06
Unit 06	**Support for pressure vessel** Bracket or lug support: Thickness of the base plate, Thickness of web (gusset) plate, Column support for bracket base plate for column or leg support. Skirt Support: Skirt design, Skirt bearing plate, and Anchor bolt design, Design of bolting chair. Saddle Support: Longitudinal bending moment, Stresses in shell at saddle.	06

MMD510.4: Process Equipment Design

Sr. No.	**Term Work**
	Assignments on
01	Design considerations for pressure vessel
02	Storage vessel
03	Pressure vessel
04	High pressure vessel
05	Agitated vessel
06	Support for pressure vessel

Sr. No. **Text Books/ Reference Books**

01 Process Equipment Design by V.V.Mahajani and S. B. Umarji. Macmillan Publisher India Ltd.

02 Process equipment design by L.E.Brownell and E.H.Young, John Wiley and Sons

03 Introduction to process Equipment Design by B.C. Bhattacharya

04 Pressure Vessel Design Manual by Dennis Moss, Elsevier

05 Theory and Design of Pressure Vessels by John F. Harvey, P. E., CBS Publication

Academic Year 2018-19 **Syllabus Structure and Contents**

MMD510.5: Product Design & Development

UnitNo.	Contents	Lecture Hrs
Unit 01	**Introduction to product design:** Approach industrial product based on idea generation and innovativeness (and inventiveness) to meet the needs of the developing society. Design and development process of industrial products, various steps such as creative process involved in idea of marketing, The Designer- his role, myth and reality, the industrial design organization,basic design considerations, Role of Aesthetics in product design, Functional design practice. Use of modeling technique, prototype designs, conceptual design.	06
Unit 02	**Design for Production:** Producibility Requirements in the design of machine components, Forging design, Pressed component design, Casting design for economical molding, eliminating defects and features to aid handling, Design for machining ease, the role of process Engineer, Ease of location and Clamping, Some additional aspects of production design, Design of powder metallurgical parts.	06
Unit 03	**Industrial Product Design and Design of Consumer Product:** General design situations, sailing specifications, requirements and ratings, their importance in the design. Study of market requirements and manufacturing aspects of industrial designs. Aspects of ergonomic design of machine tools, testing equipment, instruments, automobiles, process equipment etc. convention of style, form and color of industrial design. Design concepts of consumer products, specification requirements and rating of their importance in design, functions and use, standard and legal requirements, body/dimensions. Ergonomic considerations, interpretation of information, conversions for style, forms, colors.	08
Unit 04	**Economics Considerations:** Selection of material, design for production, use of standardization, value analysis and cost reduction, maintenance aspects of product design. Economic Factors Influencing Design: Product value, Design for safety, reliability and Environmental considerations, Manufacturing operations in relation to design, Economic analysis, profit and competitiveness, break even analysis, Economics of a new product design (Samuel Eilon Model)	08
Unit 05	**Value Engineering and Product Design:** Introduction, Historical perspective, Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, The value Analysis Job Plan, Creativity, Steps to problem solving and value analysis, Value Engg. Idea generation check list, Cost reduction, materials and process selection in value engineering. Introduction to TRIZ methodology.	06
Unit 06	**Design Organization:**Organization structure, designer's position, drawing office procedure, standardization, record keeping, legal product of design patents.	06

MMD510.5: Product Design & Development

Term Work

i) Case Studies- Design analysis of existing products

ii) Design of new products/devices, utility articles:2 cases,

iii) Assignments based on each topic

Sr. No.	**Text Books/ Reference Books**
01	Product Design and Development by Kail T Ulrich and Steven D Eppinger
02	Product Design and Development by AK Chitale and Gupta
03	Design of Systems and Devices by Middendorf Marcel Dekker
04	Industrial design for engineers – W. H. Mayall, London Ilifle books, Ltd.
05	Problems of product design and development – Hearn Buck, Pergamon Press.
06	Industrial designs in engineering – Charles H. Flurscheim design council.
07	The generation of idea for new products – Trevor Sowecy, Kogan page
08	The science of Engineering design – Percy II, Hill

Program Elective-II

MMD510.6: Robotics

Unit No.	Contents	Hrs
Unit 01	**Introduction** Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.	06
Unit 02	**Robot Grippers** Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.	06
Unit 03	**Drives and control systems:** Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers, Introduction to closed loop control Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others.	08
Unit 04	**Kinematics:** Transformation matrices and their arithmetic, link and joint description, Denavit – Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematiccalibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:-Jacobians, singularities, static forces, Jacobian in force domain. Dynamics:- Introduction to Dynamics , Trajectory generations	08
Unit 05	**Machine Vision System:** Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation. Robot Programming: Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc., Features of type and development of languages for recent robot systems.	06
Unit 06	**Modeling and Simulation for manufacturing Plant Automation** Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation. Artificial Intelligence: Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotization,Economic aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics	06

Term Work:

Minimum TEN assignments based on above topics

MMD510.6: Robotics

Sr. No. **Reference Books**

01 John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2/e, 04
02 Mikell P. Groover et. al, Industrial Robotics: Technology, Programming andApplications, McGraw – Hill International, 1986.
03 Shimon Y. Nof, Handbook of Industrial Robotics, John Wiley Co,
04 Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.
05 Industrial Automation: W.P. David, John Wiley and Sons.
06 Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 02.
07 Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

SEMESTER III

MDM 601: INDUSTRY INTERNSHIP

All the students enrolled for M.Tech. program irrespective of their program of study are required to undergo 4 weeks industry internship in industries pertaining to the respective domain of their program. This internship is aimed at giving sufficient exposure to the students regarding the working of business, various functional areas, norms of work, organization structure, products and services along with the work procedure and systems. This help the students to visualize the inter connectivity between what they learn in classes (theory) to the real world of work. It also helps to understand the expectation of industries regarding Code of Conduct, time management, commitment, planning and scheduling the work activities and meeting and analytical and critical thinking skills required. the schedule. Industry internship is to be done by the students at the end of semester II (during the vacation) or students have option to carryout internship in the company where they will take up dissertation work.

Industry Internship Program with Dissertation

It is full one year two semester program in the second year of the program semester III and IV This course aims at giving students hands on experience to imbibe in them the skills and competencies required to make them competent post graduates for employment as per the expectation of the industry where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the supervisor assigned.

OUTCOME EXPECTED AT THE END OF INTERNSHIP

After the successful completion of the internship the student should be able to,

1. Understand the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Understand and follow the safety norms, Code of conduct.

4. Demonstrate the ability to observe, analyze and document the details as per the industry practices.
5. Understand the processes, systems and procedures and to relate to the theoretical concepts-studied.
6. Analyze the company with respect to its competitors.
7. Carry out SWOT analysis of the company
8. Improve the leadership abilities, interpersonal communication.
9. Demonstrate project management and finance sense

WORK DIARY

Each student should maintain a work which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done and write the remarks/ instruction. At the end of the internship, the duly completed dairy shall be submitted to the department.

CODE OF CONDUCT:

The students should strictly abide by the rules and regulations of the company with respective to safety, timing, discipline. Any violation of the norms will view seriously and the institute may take strict action in such situation and student may face a severe setback in both his academics and career.

EXPENSES OF THE INTERSHIP TRAINING and DISSERTATION IN COMPANY:

All the expenses of the training like travelling, boarding and lodging should be borne by the students. However, if the company offers, they are eligible to get subsidized canteen facility, transport facility.

EVALUATION OF INTERNSHIP: (4 CREDITS)

The assessment of the internship will be done jointly by the industry and the faculty assigned to the students. The tentative scheme of assessment will be as follows.

Sr. No	Evaluation Parameters	Weight %
1	Punctuality, behavior and following code of conduct (to be assessed by the company personal)	20%
2	Initiative, observation and interest in learning new things (faculty in charge)	20%
3	Familiarization with specific Department/shop/function assigned to student (to be assessed by the company personal)	20%
4	Final evaluation based on presentation of work, internship report(By DPGC committee and Supervisors)	40%

Minimum 50% score is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.

MDM 603: DISSERTATION PHASE I (SYNOPSIS SUBMISSION SEMINAR)

Dissertation is a program requirement for M. Tech wherein under the guidance of a supervisor/ co-supervisor from the industry in case of industry sponsored projects, a second year student is required to some innovative/ contributory/ developmental work with the application of knowledge earned while undergoing various theory and laboratory courses. A student has to exhibit both analytical and practical skills through dissertation work.

A student is expected to carry out intensive literature survey/ identification of a major issue or problem in case of industry projects with observations and discussions in the area of interest specific to the domain in consultation with the dissertation supervisor and industry co-supervisor. The objectives and scope of the dissertation will be expected at a higher level and the use of the new analytical and computer based tools for solving the identified problem is recommended.

A student is required to submit the dissertation synopsis duly signed by supervisor and co-supervisor to the M. Tech Co- coordinator of the department who schedules the synopsis presentation seminar in the DPGC (Departmental Program Committee).

The dissertation synopsis seminar presentation comprises of the following details:

- A Dissertation title
- General introduction to the area of the :topic
- Relevance of the dissertation work
- Literature review/ prior work done in the area
- Dissertation objectives and scope
- Expected outcomes
- Methodology
- Phases of work and representation on a Gantt chart with deadlines
- Resources required to complete the work
- Commitment from the student (Ethical conduct)
- References

Based on the report and the presentation, the DPGC will give approval to the dissertation/ give suggestions/ suggest changes/modifications, additional scope,etc. specific to make dissertation to come to the expected level of PG requirement. The student will incorporate the suggestions and resubmit the same for approval.

The final copy of the synopsis with approval seal will be issued to the student, supervisor and the co- supervisor of the company which becomes the guiding document for the dissertation.

The Evaluation Guidelines:

1. Based on the initiative, the novelty and the skill in identifying the problem and collecting and analyzing the information and co-Supervisor: 50 %
2. Presentation, scope, outcomes, research compilation, relevance DPGC: 50%

MDM 605: DISSERTATION PHASE II

Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis.

Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

This phase consists of both the In- semester evaluation by the supervisor and DPGC (ISE) and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

The Evaluation Scheme	**Weight %**
Supervisor and co- supervisor	25
DPGC of the program department	25
Panel of Examiners [Chairman, internal supervisor, external expert]	50

In the DPGC Evaluation, if the progress is not found satisfactory, the student will be given the grace period of 4 weeks to work on the dissertation and present it to the committee again and on approval the ESE will be conducted. In this case, the student has to suffer one grade penalty and the next semester Phase III starts only on satisfactory completion of Phase II.

SEMESTER IV

MDM 602: DISSERTATION PHASE III

This stage marks the final progress review which indicates the completion of all the defined phases of the dissertation satisfactorily on the periodic progress reviews by supervisor and co-supervisor. A student by this time has used an opportunity to present his dissertation work in a reputed international/national conference to receive the feedbacks/ comments on the work and any new dimension to be incorporated to make the work novel and worthy of publishing in peer reviewed journals and should also prepare a journal paper based on the complete work of dissertation with results, discussions and conclusions.

A student is required to prepare the draft dissertation report as per the format of the university and with approval of supervisor and co- supervisor submit the same to the PG program coordinator of department.

The Program coordinator will schedule the presentation of student (Pre submission)before the DPGC members once the student has completed all the academic requirements for the prescribed program.

1. Submission of Draft Dissertation Report
2. Completion of internship
3. Completion of the online/self-study.
4. Earning 100% credits of Sem I to III
5. Proof of presentation of the work in the International Conference (Certificate publication and draft paper in a template for an identified journal/uploading of same in peer reviewed journal)

Based on the recommendation of DPGC, the dissertation is processed further.Viva-Voceexamination is to be scheduled preferably with the same external expert appointed for the Dissertation Phase II by COE.

The successful completion of the Viva- voce, the panel of examiners recommends the candidate as successfully completed and submits the evaluation in the sealed envelope.

Evaluation Scheme for Phase III

Sr. No	Evaluator	Weight %	Min. Passing %
1	Supervisor and Co supervisor	50	50
2	DPGC Committee	50	

If the DPGC committee is of the opinion that a student is required to work further to achieve the stated objectives and incorporate some additional work, an extension based on the work is given to the student to complete the work and the student is required to re-submit the dissertation and a presentation is to be given to DPGC. The DPGC will take a final decision on whether to schedule the final exam or give additional extension of the work.

MDM 604: DISSERTATION PHASE IV

Evaluation Scheme for Phase IV

Evaluator	Weight%	Min. for Passing%
External Viva-voce examination by a panel (ESE)	100	50%

MDM 606: Dissemination of Outcomes of Dissertation

It is mandatory on the part of the student to,

1. Participate and present a paper in a reputed national/ international conference organized by the premium institutions/ professional bodies. It is recommended to participate and publish in conferences whose proceedings are published by IEEE, Elsevier Springer, Materials Today or any other reputed conferences.
2. A paper for a peer reviewed journal is to be prepared as per the journal format and uploaded to the journal website. It is desirable that at least the paper will be selected in initial review regarding Scope and it enters the second phase of editor
3. If the work of a student is novel and patentable in this case, a student need not have to bring his research findings in public domain through publication but he can file the patent. Student should be able to get provisional registration of patent with patent office.
4. In case of NDA with company when student is pursuing his dissertation, publication may not be possible in public domain. These cases are to be treated as special cases. A rubric is developed for evaluation.

The evaluation of the dissertation work of a student shall be carried out in four phases: First and third phase being evaluated for ISE by Department Post Graduate Committee (DPGC) while second and fourth phase by DPGC for ISE and by a panel of examiners for ESE. Except for phase I evaluation i.e. evaluation based on synopsis submission seminar, a student shall be evaluated for all other phases for his/her understanding, the work done and his/her presentation followed by demonstration.

DPGC shall consist of three faculty members from the department, Guide assigned to a student being one of the members. A panel of examiners for ESE shall consist of Chairman (who shall be one of the DPGC members and shall monitor the process as per norms), an Internal Examiner (who shall be the Guide) and an External Examiner (who shall be a subject expert from outside the institute).
