Choice Based Credit System Syllabus
(W.e.f. June 2015-16)

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Structure of M.E.-Mechanical (Design Engineering)

PART-I

Sr.No	Name of the Subject	Teaching Scheme			Examination Scheme			
		Lectures	Tutorials	Practical	Theory Paper Marks	Term Work Marks	Oral Marks	Total Marks
1	**Computational Techniques in Design Engineering**	3	--	2	100	25	--	125
2	**Machine Dynamics**	3	--	2	100	*	25	125
3	**Solid Mechanics**	3	1	--	100	25	--	125
4	**Design of Experiments And Research Methodology**	3	1	--	100	*	25	125
5	**Elective –I**	3	1	--	100	25	--	125
6	**Seminar I**	--	--	2	--	25	-	25
	Total	**15**	**3**	**6**	**500**	**100**	**50**	**650**

PART-II

Sr.No	Name of the Subject	Teaching Scheme			Examination Scheme			
		Lectures	Tutorials	Practical	Theory Paper Marks	Term Work Marks	Oral Marks	Total Marks
1	**Advanced Design Engineering**	3	1	--	100	*	25	125
2	**Finite Element Analysis**	3	--	2	100	*	25	125
3	**Experimental Stress Analysis**	3	--	2	100	25	--	125
4	**Industrial Product Design**	3	1	--	100	25	--	125
5	**Elective II**	3	1	--	100	25	--	125
6	**Seminar II**	--	--	2	--	25	-	25
	Total	**15**	**3**	**6**	**500**	**100**	**50**	**650**

Elective –I	Elective –II
1) Synthesis & Analysis of Mechanisms and Machines	**1) Industrial Tribology**
2) Industrial instrumentation	**2) Engineering Fracture Mechanics**
3) Reliability Engineering	**3) Theory and Analysis of Composite Materials**
4) Mechanical System Design	**4) Engineering Design Optimization**

- In-plant training report for the training of at least one month undertaken after semester II is to be submitted in semester III.
- The Oral examination is to be conducted by one internal and one external examiner appointed by university.
- *Quality of Term Work of the subject may also be considered during oral examination.

- Seminar I and Seminar II is to be conducted by one internal and one external examiner from outside university area appointed by university.

PART-III

Sr.No	Name of the Subject	Teaching Scheme			Examination Scheme			
		Lectures	Tutorials	Practical	Theory Paper Marks	Term Work Marks	Oral Marks	Total Marks
1	**In-plant Training**	--	--	1	--	50	--	50
2	**Mini Project (Based on Dissertation)**	--	--	4	--	50	50	100
Total		**--**	--	**5**	--	**100**	**50**	**150**

PART-IV

Sr.No	Name of the Subject	Teaching Scheme			Examination Scheme			
		Lectures	Tutorials	Practical	Theory Paper Marks	Term Work Marks	Oral Marks	Total Marks
1	**Dissertation**	--	--	5	--	200	100	300
Total		**--**	--	**5**	--	**200**	**100**	**300**

- The Viva-voce on dissertation work is to be arranged only after submission of paper based on dissertation work carried out and acceptance of one paper in International conference or Journal

SOLAPUR UNIVERSITY, SOLAPUR

SEM-I

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 1 Computational Techniques in Design Engineering

Teaching Scheme
Lectures: 3 Hours / week
Practical: 2 Hours / week

Examination Scheme:
Theory: 100 marks
TW: 25 marks

1. Data Analysis : Errors in numerical calculations, Interpolation by central differences, sterling Bessel & Everett Formulae, Interpolation Formula for unequal Intervals, Spline Interpolation, Cubic Splines. **(04)**
2. Curve Fitting: Least square method for linear & non-linear functions, weighted least square methods. **(04)**
3. Solution of Linear System of Equations : Gauss Elimination with Pivoting, LU Decomposition method, Iterative methods, Eigen vectors-Jacobi method, Jacob's method,Gauss Siedel method. **(06)**
4. Numerical Differentiation & Integration: Differentiation by Finite Differences, Numerical Integration by Newton-Cotes formula & Gauss Quadrature. **(06)**
5. Solution of Ordinary Differential Equation : Picard's Method, Euler's & Modified Euler's Method, Runge-Kutta Method (up to fourth order), Predictor-Corrector Methods, Milne Sompson, Adams Bashforth Moulten Methods. **(04)**
6. Boundary value and Eigen value problems: Shooting method, finite difference method to solve boundary value problems, Polynomial method, power method to solve Eigen value problems. **(06)**
7. Solution of Partial differential equations: Finite difference method, solution of Laplace & Parabolic equations. **(05)**
8. Mathematical Modeling of Physical Problems, modeling Concept, Modeling of Linear Differential Equations of Second order. **(05)**

Term Work

Minimum ten computer programs based on above syllabus should be developed and recorded in the journal.

Books Recommended

1.Dr. B.S. Grewal, Numerical methods for science & Engg., Khanna publications.

2.M.K.Jain, Numerical methods for Scientific & Engg. Computation, New age international publication.
3. E.Balagurusamy, Numerical methods, Tata Mc Graw Hill Publications.
4. S. S. Shastry, Introductory methods of numerical analysis, Third edition, Prentice hall of India publications pvt. Ltd.
5.Swami, Saran Singh, Computer programming and numerical methods.
6.J.N.Kapoor, Mathematical modeling

SOLAPUR UNIVERSITY, SOLAPUR

SEM-I

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 2 Machine Dynamics

Teaching Scheme
Lectures: - 3Hrs/week
Practical: - 2hr/week

Examination Scheme:
Theory - 100Marks
Oral - 25Marks

Course Objective: The objective of this course is to familiarize the student with the underlying concepts of linear mechanical vibrations through analysis of the free and forced responses of various single and multiple degree-of-freedom (DOF) systems.

1 Single Degree of Freedom System **(05)**

-Free Vibration Response of undamped and damped system, free vibration with viscous and coulomb damping

-Response of single DOF system to Harmonic and periodic excitation , rotating unbalance, Harmonic Motion to base excitation and vibration isolation, whirling of shaft/rotor systems, Response to periodic excitations using Fourier series.

-Response of single DOF systems to non-periodic excitation; impulse and step response, convolution, Response of Arbitrary Excitation, shock spectrum.

2 Two Degree of Freedom System **(06)**

-Introduction,
-Equation of motion for forced vibration,
-Free Vibration analysis of an undamped system, Torsional System,
-Coordinate coupling and principal coordinates,
-Forced Vibration of undamped and damped system,
-Dynamic Vibration Absorber

3 Multi Degree of Freedom System **(06)**

-Equation of motion for multidegree freedom system
-Lagrange's equation to derive equation of motion
-Free Vibration of undamped system: Natural Frequency and mode shape
-Free Vibration of Damped System: Rayleigh Damping and Viscous damping
-Forced Vibration of Multi-degree Freedom system: Modal Analysis of undamped and damped system

4 Numerical Techniques to find Natural Frequency **(03)**

-Methods of determination of natural frequencies of many DOF Systems

--Rayleigh'sMethod, HolzerMethod, Matrix IterationMethod.

5 Vibration Analysis of Continuous System **(04)**

- Vibrations of String, Bars, Shafts and beams, free and forced vibration of Continuous systems.

6 Nonlinear Vibrations **(06)**

-Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping,
-Determination of Nonlinear Vibration: phase-plane technique, Perturbation Method
-Forced Vibration with Non linear spring (Duffing's equation).

7 Random Vibration Analysis **(06)**

-Introduction to Random variable and random processes,
-Probability distribution, Mean Square values and standard deviation, probability density function, wide band and Narrow ban processes Power spectral Density
-Response of linear systems to stationary excitation.

8 Vibration Measurement (only Theoretical Treatment) **(04)**

-FFT analyzer, vibration exciters,
-Signal analysis: Time domain & Frequency domain, analysis of signals.
-Experimental modal analysis,
-Machine Conditioning and Monitoring, fault diagnosis

Term Work:-
At least eight assignments/experiments based on above topics.

Reference Books:-

1. **Theory of Vibrations with Applications**: W T Thomson CBS Publishers Delhi
2 .**Mechanical Vibrations** : S S. Rao Addison-Wesley Publishing Co.
3 .**Fundamentals of Vibration** : Leonard Meirovitch , McGraw Hill International Edison.
4 .**Principles of Vibration Control** :Ashok Kumar Mallik, Affiliated East-West Press.
5 .**Mechanical Vibrations** A H Church ,John Wiley & Sons Inc
6 .**Mechanical Vibrations** J P Den Hartog ,McGraw Hill.
7 .**Mechanical Vibration Analysis: Srinivasan** ,McGraw Hill.
8 .**Mechanical Vibrations:** G K Grover.
9 .**Vibrations and Noise for Engineers**: Kewal Pujara, Dhanpat Rai& co.
10. **Mechanical Vibrations** :V.P.Singh.

SOLAPUR UNIVERSITY, SOLAPUR
SEM-I

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 3 Solid Mechanics

Teaching Scheme
Lectures: 3 Hours / week
Tutorial: 1 Hours / week

Examination Scheme:
Theory: 100 marks
TW: 25 marks

1. Plane stress and Plane strain: Differential equations of equation of equilibrium, Boundary conditions, Compatibility, Stress function and Bi harmonic equation. **(5)**
2. Two dimensional problems in Rectangular co-ordinates. Applications to polynomials in rectangular co-ordinates, Saint Venant's Principle. **(5)**
3. Two dimensional problems in Polar co-ordinates: General equations in polar co-ordinates, Pure bending of curved bars, Strain components in polar co-ordinates, Rotating disks, Stresses in a circular disks. **(7)**
4. Shear center. Shear stress distribution and Shear center for thin walled open sections. **(6)**
5. Torsion: Torsion of bars with elliptical, square & rectangular cross section. Membrane analogy, Hydro dynamical analogy, Torsion of hollow & thin tubes. **(6)**
6. Membrane stresses in shell and storage vessels, Shells and vessels of uniform strength. **(5)**
7. Contact stresses Problem, of determining contact stresses, Assumptions, Expressions for principle stresses, Examples. **(6)**

Term Work

10 to 12 study assignments / tutorials based on above topics.

Books recommended

1. S. Timoshenko & J.W. Goodeer,"Theory of Elasticity", MGH books co Ltd.
2. J.P.Den Hartog, "Advanced Strength of Materials." MGH books co Ltd.
3. F.B. Seely & Smith, "Advanced mechanics of materials", John Wiley & Sons.

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 4 Design of Experiments And Research Methodology

Teaching Scheme
Lectures: 3 Hours / week
Tutorial: 1 Hours / week

Examination Scheme:
Theory: 100 marks
Oral: 25 Marks

1. **Introduction:** Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsoring agent's requirements, Ethical, Training, Cooperation and Legal aspects. **(5)**
2. **Research Design:** Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research. **(5)**
3. **Research Problem:** 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. **(4)**
4. **Research Modelling:** (a) Mathematical – Classification of Models, Development of Models, Stages in Model building, Principles of Modelling, Use of Analogy, Models as Approximations, Data consideration and Testing of Models (b) Heuristics and Simulation – Definition, Applications and reasons for using Heuristics, Heuristic Methods and approaches, Meta-Heuristics; Simulation – Meaning, Applications and Classification of Simulation Models, Process of Simulation, Steps and Features of Simulation Experiments and their Validation. **(7)**
5. **Experimentation:** Objective, Strategies, Factorial Experimental Design, Applications of Experimental Design, Basic Principles – Replication, Randomization and Blocking, Guidelines for designing experiments; Laboratory Experiments, Methods of manipulating Variables, Errors in Experiments, Steps in Design of Experiments, Basis. **(6)**
6. **Process Optimization:** Factorial Design principles, Two factor Factorial Design, General Factorial Design, Fitting response Curves and Surfaces, Blocking, Taguchi Approach to Parameter Design, Robust Design. **(7)**
7. **Analysis:** Analysis of Variance and Co-variance, Hypothesis Testing – Parametric and Non-Parametric Tests, Uni-variate and Bi-variate analysis **(3)**

8. **Report Writing:** Pre-writing Considerations, Principles of Thesis Writing, Formats of Report Writing & Publication in Research Journals, Oral Presentations (Briefing) **(3)**

Term work:

1. Collection and review of literature on a specific topic related to design or manufacturing engineering.
2. Assignment on data collection processing, analysis, interpretation, inferences and conclusions for an engineering problem.
3. Assignment on design of experiments using Taguchi technique.
4. Assignment on modeling and simulation of an engineering problem.
5. Presentation of any one above using MS power-point or similar.

Reference Books:

1. Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, 5/e. (New York, John Wiley & Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, 2/e. (New Delhi, New Age International Ltd. Publishers)
4. Ross, Phillip J. (1996) – Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
5. Rao S. S. (2004) – Engineering Optimization Theory & Practices, 3/e (New Delhi, New Age International Ltd., Publishers)
6. Handbook of Industrial Automation – Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
7. Trochim, William M.K. (2003), - Research Methods 2/e, (New Delhi, Biztantra, Dreamtech)

SOLAPUR UNIVERSITY, SOLAPUR
SEM-I

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.1 Elective –I: Synthesis and Analysis of Mechanisms and Machines

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs per week	**Theory: 100 Marks**
Tutorial: 1 Hours / week	**TW: 25 marks**

1. Basic Concepts: Definitions and assumptions, planar and spatial mechanisms, kinematic pairs, degree of freedom **(4)**

2. Kinematic Analysis Of Complex Mechanisms: velocity-acceleration analysis of complex mechanisms by the normal acceleration and auxiliary point methods. **(5)**

3. Dynamic Analysis of Planar Mechanisms: - Inertia forces in linkages, kinetostatic Analysis of mechanisms by matrix method. Analysis of elastic mechanisms, beam element, displacement fields for beam element, element mass and stiffness matrices, system matrices, elastic linkage model, equations of motion. **(6)**

4. Curvature theory: Fixed and moving centrodes, inflection circle, Euler- Savy equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell Mechanisms. **(6)**

5. Graphical Synthesis of Planar Mechanisms: Type, number and dimensional synthesis, function generation, path generation and rigid body guidance problems, accuracy (precision) points, Chebychev Spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, center point and circle point curves, Bermester points, Synthesis for five accuracy points, Branch and order defects, Synthesis for path generation. **(7)**

6. **Analytical synthesis of Planar Mechanisms**:- Analytical synthesis of four-bar and slider- crank mechanism, Freudenstein's equation, synthesis for four accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers. Complex numbers method of synthesis, the dyad, center point and circle point circles, ground pivot specifications, three accuracy point synthesis using dyad Method, Robert Chebychev theorem, Cognates **(7)**

7. Kinematic Analysis of Spatial Mechanisms : Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms. **(5)**

Term Work:
Any eight assignments based on the above syllabus

Reference Books:

1. Theory of Machines and Mechanisms, A. Ghosh and A.K.Mallik, Affiliated East-West Press.
2. Kinematic Synthesis of Linkages, R. S. Hartenberg and J. Denavit, McGraw-Hill.

3. Mechanism Design - Analysis and Synthesis (Vol.1 and 2), A. G. Erdman and G. N. Sandor, Prentice Hall of India.
4. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, 2nd Ed., McGraw-Hill.
5. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L.Norton, Tata McGraw-Hill, 3rd Edition.
6. Kinematics and Linkage Design, A.S.Hall, Prentice Hall of India.

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.2 Elective –I: INDUSTRIAL INSTRUMENTATION

Teaching Scheme:
Lectures: 3 Hrs per week
Tutorial: 1 Hours / week

Examination Scheme:
Theory: 100 Marks
TW: 25 marks

1. Introduction to Instruments and the representation
   Typical Applications, Functional Elements, Classification of instruments, Microprocessor based instrumentation, Standards & Calibration **(4)**

2. Static and Dynamic characteristics of Instruments
   Static performance parameters, Selection of instrument, Dynamic performance characteristics like time lag, dead zone, fidelity etc., types of inputs, zero order, first order & second order instruments, dynamic response for step input & periodic harmonic input only. **(4)**

3. Transducer elements, Intermediate elements, Indicating and recording elements. **(4)**

4 Displacement measurement, Force measurement, torque& power measurement. **(4)**

4. Pressure and vacuum measurement, Flow measurement. **(4)**

5. Temperature measurement: Thermocouples, R.T.D., Thermistors, Radiation & Optical Pyrometers **(4)**

7. Measurement of vibration& Sound, vibrometer , accelerometers, Seismic instrument, Sound Level Meter, Noise analysis **(4)**

8. Signal and systems Analysis: Analog Filters & Frequency Analyzers, Frequency analysis Harmonic & Transient Testing, Random Force Testing **(4)**

9. Condition monitoring and Signature Analysis Applications: Vibration & Noise monitoring Permanent Monitoring System, Wear Behaviour Monitoring, Corrosion Monitoring **(4)**

10. Data acquisition Systems, Data Display & Storage **(4)**

Term Work

At least eight Experiments/Assignments based on above Syllabus.

Reference Books

1. B.C.Nakra and K.K. Choudhry, Instrumentation, Measurement and Analysis, Tata-McGraw Hill Education Pvt. Ltd. New Delhi. (Third Edition)
2. Ermest O. Doebelin, Measurements systems: Application & Design, TataMc-Graw Hill Publication,NewDelhi.
3. D.S. Kumar, Mechanical Measurements and Control

SOLAPUR UNIVERSITY, SOLAPUR
SEM-I

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.3 Elective –I: RELIABILITY ENGINEERING

Teaching Scheme:
Lecture: 3 Hrs/week
Tutorial: 1 Hrs/week

Examination Scheme:
Theory: 100 Marks
TW: 25 Marks

1. Concepts of Quality Engineering, Taguchi's Approach to Quality, On-line and Off-line Quality Control, Difference from Classical Approach, Quality Loss Function, System Design, Parameter Design, Classification of Parameters, Parameter Design Strategy Tolerance Design, Causes of Variation, **(4)**

2. Robust Design, Quality Characteristics and Objective Functions, Control Factors and their Levels, Testing Conditions, Planning and Conducting the Experiment **(2)**

3. Brief revision of Probability Mathematics - Concept, Definitions, Rules of probability, Probability distributions used in Reliability : Continuous distributions – Normal, Lognormal, Exponential, Gamma, Chi-squared, and Weibull distribution, Discrete distributions – Binomial, Poisson, and Negative binomial distribution, Least Square Curve Fitting Methods, Bayesian theorem of Probability. **(6)**

4. Introduction to Reliability Engineering : History, definition, application of Reliability, Reliability Function-R(t), Probability density Distribution Function (PDF) - f(t), Cumulative probability Distribution Function (CDF) - F(t) Hazard Rate Function-Z(t). Mean Time To Failure –MTTF, Mean Time Between Failures MTBF. Relations between R (t), f (t), F (t), Z (t), MTTF & MTBF. Hazard Rate models, life Cycle of Product, Bath tub curve, Failure data analysis for discrete data. Relationship between Various Reliability Characteristics, Time-dependent Hazard Models– Constant-hazard, Linear-hazard, Nonlinear-hazard **(8)**

5. Failure Mode analysis fault Tree & Success Tree Methods, Symbols used, Failure Mode Effectiveness & criticality Analysis. **(3)**

6. Component Reliability, System Reliability, Series Models, Parallel Models, Series-parallel and Parallel-series Models, k-out-of-m Models, Mixed & Complex system models Redundancy (active, standby), **(10)**

7. Introduction to Availability & Maintainability, Maintained Systems, Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance **(4)**

8. Reliability Testing, Product testing ,Life testing bum-in testing , acceptance Testing , accelerated life testing , Reliability growth. Reliability Design of elements Strength & Duty Distribution , Factor of safety, Simple example of design of elements with reliability **(3)**

Term Work:

Minimum Six assignments on related topics, which should include at least one case study.

Reference Books:

1. Phadke, M. S., Quality Engineering using Robust Design, Pearson, (2008).
2. Ross, Taguchi Techniques for Quality Engineering, McGraw Hill. (2005).
3. E Balguruswamy, Reliability Engineering, Tata McGraw Hill. (2003).
4. Patric D.T.O'Connor, Practical Reliability Engineering, Wiley (2008)

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.4 Elective –I: MECHANICAL SYSTEM DESIGN

Teaching Scheme:
Lecture: 3 Hrs/week
Tutorial: 1 Hrs/week

Examination Scheme:
Theory: 100 Marks
TW: 25 Marks

1. Engineering process and System Approach
Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering. **(4)**

2. Problem Formulation
Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint. **(4)**

3.System Theories
System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach. **(4)**

4. System modeling
Need of modeling, Model types and purpose, linear systems, mathematical modeling, Concepts. **(4)**

5. **Graph Modeling and Analysis**
Graph Modeling and analysis process, path problem, Network flow problem. **(4)**

6. Optimization Concepts
Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. **(3)**

7. System Evaluation
Feasibility assessment, planning horizon, time value of money, Financial analysis. **(4)**

8. Calculus Method for Optimization
Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints. **(4)**

9. Decision Analysis
Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem. **(4)**

10. System Simulation

Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach. (**5)**

Term Work

Ten case studies based on above topics (One case study for each topic).

Books/References-

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-S.S. Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.
7. Mechanical System Design – Siddiqui, Manoj Kumar Singh; New Age International
8. Machine Design -Dieter

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M.E.-Mechanical (Design Engineering) Syllabus
Sub: 6 Seminar I

Practical: 2 Hours / week **TW: 25 marks**

Topic Selection: Topic should be based on the literature survey on any topic relevant to Design Engineering. At least five journal papers should be referred for topic selection. It is desirable that the selected topic may be leading to selection of a suitable topic of dissertation.

Report: Each student has to prepare a write-up of about 25to 50 pages. The report typed on A4 sized sheets and bound in the necessary format, should be submitted after approved by the guide and endorsement of the Head of Department.

Seminar Delivery: The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.

SOLAPUR UNIVERSITY, SOLAPUR

SEM-II

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 1 Advanced Design Engineering

Lectures: 3 Hours / week **Theory: 100 marks**
Tutorial: 1 Hours / week **Oral: 25 Marks**

1. Design or High speed cams : Types of cams, Kinematic design, Standard contours, combined motion and polynomial approaches, CEP and CPM cams, Importance of SVAJ diagrams, Dynamic design of cams- rigid body analysis and elastic body analysis, Polydyne cams. **(5)**
2. Introduction to Tribology : Introduction, Friction, Wear, Wear characterization, Lubrication, Newton's law of viscous forces, effect of pressure and temperature on viscosity. **(5)**
3. Hydrodynamic lubrication: Pressure development mechanism, Converging and diverging films and pressure induced flow, Reynold's eqation with assumptions. **(5)**
4. Hydrodynamic journal bearing: Introduction to idalized full journal bearings, Load carrying capacity of idealized full journal bearings, Sommerfeld number and its significance, Numerical problems. **(6)**
5. Introduction to Hydrostatic and Elasto hydrodynamic bearings. **(4)**
6. Introduction to Reliability in Design : Definitions of Reliability function,Terms use in reliability, Failure distribution function, Hazard rate, MTTF, MTBF and MTTR, Failure data analysis, Reliability of systems – Series, parallel and combined systems, Calculation of reliability terms for exponential, Rayleigh and Weibull failure distribution function. Methods of improving reliability. Numerical problems **(6)**
7. Design based on Thermal stresses: Definition of thermal stress, applications, Form and continuity conditions, Thermal stresses in flat walls and cylindrical shells, addition of thermal and working stresses, methods of heat removal and decreasing the thermal stresses. **(5)**
8. Design for manufacturing and Assembly. **(4)**

Term work: Min. 6 exercises based on above syllabus.

Text and reference books:

1. Theory of Machines and mechanisms by J.E.Shigley (TMGH)
2. Dynamics of Machinery by Norton (TMGH)
3. Pressure vessel design by Harvey
4. Introduction to Tribology of bearing by Majumdar (Wheeler publication)
5. Theory of Hydrodynamic Lubrication by Pinkus 'O' Stemitch.
6. Tribology in Industry by Susheel Kumar Srivastav (S.Chand & Co.)
7. Reliability Engineering by E. Balguruswamy (TMGH)
8. Concepts in Reliability engineering by L.S.Srinath (East West press pvt ltd.)
9. Mechanisms and Design of cam mechanisms by Fan Y Chen (Pergamon Press inc.)

SOLAPUR UNIVERSITY,SOLAPUR
SEM-II

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 2 Finite Element Analysis

Lectures: 3 Hours / week **Theory: 100 marks**
Practical: 2 Hours / week **Oral: 25 Marks**

1. Problem Solving techniques in Engineering: Analytical Techniques in Solid Mechanics and Fluid Mechanics, Numerical Techniques such as FEM, BEM, FDM and FVM, Computational Mechanics and Engineering Experimentation. Overview of CAE and major CAE software. **(4)**
2. Mathematics for Finite Element Methods: Matrix Algebra, Vector, Tensors, Linear Algebra, PDE, ODE, Variational Calculus, Weighted Residual method. **(6)**
3. Finite Element Analysis Concepts
    a. Energy techniques in Mechanics, Concept of functional, Rayleigh-Ritz method, one dimensional bar element, one dimensional thermal element.
    b. Governing differential equations, Weighted Residual methods – Strong form and weak form, one dimensional bar element, one dimensional thermal element.
    c. Types of Finite Element formulation, the FEM process, interpretation of FEM, FEM history and evolution. **(10)**
4. FEM Modeling:
    a. Direct Stiffness method, DOF, nodes, elements, boundary conditions, assembly and solution of displacement equations
    b. Shape functions, derivation of shape functions for 1D, 2D and 3D elements, polynomial, Hermite polynomial and Lagrangian polynomial shape functions, convergence of shape functions.
    c. Isoparametric Formulation: Basic concept, Isoparametric, sub parametric and super parametric elements, co-ordinate systems, mapping, assembly of equations, Numerical integration
    d. Finite Elements: 1D, 2D, 3D elements, element classification, mesh refinement, mesh validity checks, sub modeling and sub structuring. **(10)**
5. Applications of FEM to Engineering problems (Software based course):
    a. Structural Analysis: Static analysis, buckling analysis, modal analysis, transient analysis, spectrum analysis, nonlinear analysis (Geometric non -linearity, material non linearity and contact non linearity).
    b. Thermal Analysis: Conductive, Convective and radiation analysis.
    c. Coupled Field Analysis, Fatigue analysis, CFD (elementary level). **(10)**

Term Work

1) Minimum six hand written assignments on the above topics
2) Minimum six software based assignments on Chapter 5.

List of Recommended Books

Sr. No	Title	Author / Authors	Publisher
1	Finite Element Procedures	Klaus-Jurgen Bathe	PHI
2	The Finite Element Method: Its Basis and Fundamentals	O.C. Zienkiewicz	Elsviver
3	A First Course in Finite Element Methods	Darryl Logan	Cengage
4	An Introduction to the Finite Element Method	J.N Reddy	McGraw Hill
5	Concept and Applications on Finite Element Analysis	Cook, Malkas, Plesha	Wiley
6	The Finite Element Method in Engineering	S.S. Rao	Pergamon
7	A text book of Finite Element Analysis	P.Sheshu	PHI
8	Introduction to Finite Elements in Engineering	Chandrupatla, Belegundu	PHI

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M.E.-Mechanical (Design Engineering) Syllabus

Sub 3: EXPERIMENTAL STRESS ANALYSIS

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
TW: 25 Marks

1. Principles of Experimental approach: Introduction to ESA, Advantages of ESA techniques, Necessity of various ESA methods, methodology of problem solving by ESA **(5)**

2. Strain Measurement Techniques : Introduction to strain measurement: Review of Stress, Strain, and Hooke's Law: Definition of Stress and Strain Tensors, Strain gauges: Properties of Strain gauge Systems, Types Resistance Strain gauges: Construction, Mounting methods, gauge Sensitivity, Strain gauge Circuits: Wheatstone bridge, constant current circuits Calibration of circuits, Bridge Sensitivity and Measurement Corrections, Thermal Corrections gauge Factor, Performance Characteristics, Environmental effects. Recording Instruments: Static and Dynamic Recording, **(8)**

3. Strain Analysis Methods: Three element rectangular strain rosette, correction, stress gauges, over-deterministic methods for strain analysis, residual stress determination Applications: Application of strain gauges for measurement of load, temperature, pressure, vibration, stress and strain etc. **(5)**

4. Optical Methods of Stress Analysis: Basic of Optics, Optical Instrumentation Moire Fringe technique-theory and experimental procedures, Fractional fringe measurement -Tardy's Method , Babinet Soleil Method. **(5)**

5. Theory of Photoelasticity, Polariscope- Plane polariscope, Circular polariscope, Different Arrangements photoelastic photography, Photoelastic materials-properties, selection, casting methods, calibration. Analysis Techniques-Determination of direction of Principal stresses at given point, Determination of exact fringe order N and the principal stress Separation methods, Method based on Hooke's Law, Electrical analogy method, Oblique incidence method,Shear difference method, Scaling model results to prototype. Application of photoelasticity to 2-D and 3-D Stress analysis. **(8)**

6. Optical methods for Determining Fracture Parameters- Irwins methods, application of moiré and isopachic fringe pattern to determine stress intensity factor, mixed mode intensity factor **(3)**

7. Coating Techniques- Birefringent coating- stress-optic and strain-optic relation, sensitivity and coating materials, fringe order determination. Brittle coating technique. **(3)**

8. HOLOGRAPHY: Plane and spherical waves - coherence - holographic setup - Interferometry- Displacement measurement -obtaining Isopachics, **(3)**

Term Work:

Any eight assignments based on above syllabus.

References:

1. Sadhu Singh – Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.
2. JW Dalley and WF Riley, Experimental Stress Analysis, McGraw Hill Book Company, N.Y. 1991
3. L.S.Srinath et al, Experimental Stress Analysis, Tata McGraw Hill Company, New Delhi, 1984
4. R.S.Sirohi, HC Radhakrishna, Mechanical Measurements, New Age International (P) Ltd. 1997
5. F.K Garas, J.L. Clarke and GST Armer, Structural assessment, Butterworths, London, 1987
6. D.E. Bray & R. K.Stanley, Non-destructive Evaluation
7. Dove and Adams, Experimental Stress Analysis and Motion Measurement, Prentice Hall of India, 1965.

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 4 Industrial Product Design

Lectures: 3 Hours / week **Theory: 100 marks**
Tutorial: 1 Hours / week **TW: 25 marks**

1. Introduction:
Approach to Industrial design.
Approach to 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, Designers, mind criticism, design, quality and maintainability considerations in product design. Use of modeling technique, prototype designs, conceptual (Conceptional design) **(8)**

2. Industrial Product Design:
1. General design situations, setting specification, requirements and rating, their importance in the design. Study of market requirements and manufacturing aspects of industrial designs.
2. Aspects of ergonomic design of machine tools, testing equipments, instruments, automobiles, process equipments etc., convention of style, form and color of industrial design. **(8)**

3. Design of Consumer Product:
1. Design concepts of consumer products, specification requirements and rating of their importance in design. Functions and use, standard and legal requirements, body/dimensions.
2. Ergonomic considerations, interpretation of information, conversions for style, forms, colors **(8)**

4. Aesthetic Concepts:
1. Concept of unity and of order with variety, concept of purpose, style and environment, Aesthetic expressions of symmetry, balance, contrast continuity, proportion, rhythm, radiance.
2. Form and Style of Product: Visual effect of line and form, mechanics of seeing, psychology of seeing. Influence of line and form. Components of style, basic factors, house style. Effect of color on product, appearance, color composition, conversion of colors of engineering products. **(9)**

5. Economic Considerations: Selection of material, Design for production, use of standardization, value analysis and cost reduction, maintenance aspects of product patents. **(7)**

Term Work –
i) Case Studies:- Design Analysis of existing products ii) Design of new products devices utility articles:- 2 cases iii) Assignments based on the above topics.

REFERENCE BOOKS

1. Industrial Design for Engineers – W. H. Mayall, London Ilifle books Ltd.
2. Problems of Product Design and Development- Hearn Buch, Pergamon Press
3. Industrial Designs in Engineering – Charles H. Flurscheim, Design council

4. The Generation of Idea for New Products- Trevor Sowecy, Kogan Page.
5. The Science of Engineering Design- Perey H. Hill.
6. Engineering Design, Conceptual Stage-M. J. French Heinman Education Books.
7. Material of Inension- Ezia Manzim

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SEM-II

M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.1- Elective II Industrial Tribology

Teaching Scheme
Lectures: 3 Hrs per week
Tutorial : 1 Hours / week

Examination Scheme:
Theory: 100 Marks
TW: 25 marks

1. Friction and Wear:-
Friction Control and Wear prevention, Boundary Lubrication, Tribological properties of Bearing Materials and Lubricants, Theories of friction and wear, instabilities and stick-slip motion. **(7)**

2. Lubrication of Bearings:-
Mechanics of Fluid Flow, Reynold's Equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution). **(6)**

3. Finite Bearings:-
Hydrostatic, Hydrodynamic and thrust oil bearings, heat in bearings. **(5)**

4. Hydrostatic squeeze film:-
Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings. **(4)**

5. Elasto-hydrodynamic Lubrication:-
Pressure-viscosity term in Reynold's Equation, Hertz theory, Ertel-Grubin Equation, lubrication of spheres. **(7)**

6. Air lubricated bearings:-
Tilting pad bearings, hydrostatic, hydrodynamic and thrust bearings with air lubrication. **(5)**

7. Tribological aspects of rolling motion:-
The mechanics of tyre-road interaction, road grip and rolling resistance, Tribological aspects of wheel on rail contact, Tribological aspects of metal rolling, drawing and extrusion. Tribo characteristics of different materials, Evaluation of friction & wear through experiments under influencing parameters, *pV* value of materials. **(6)**

Term Work:

Eight Assignments based on Design of acoustic thrust bearings, Squeeze film lubrication of piston pin, Heat balance in bearings, Reynold's Equation**,** Journal Bearing Apparatus**,** Tilting pad and

thrust Bearing Apparatus**,** Study of lubrication systems. Friction in Journal Bearings, Four Ball Tester**,** Coefficient of friction using pin on disc type friction monitor, Brake line friction test rig.

Reference Books –

1. Basic Lubrication Theory- A Camaron
2. Principles of Lubrication – A Camaron, Longman's Green Co. Ltd.
3. Theory and Practice for Engineers – D. D. Fuller, John Wiley and sons.
4. Fundamental of Friction and Wear of Metals – ASM
5. The Design of Aerostatic Bearings – J. W. Powell
6. Gas Bearings – Grassam and Powell
7. Theory Hydrodynamic Lubrication Pinkush and Sterrolicht
8. Tribology in Machine Design – T. A. Stolarski

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.2 Elective II- Engineering Fracture Mechanics

Teaching Scheme
Lectures: 3 Hours / week
Tutorial : 1 Hours / week

Examination Scheme:
Theory: 100 marks
TW: 25 marks

1.Introduction:-
Review of - Mechanical properties of solid materials, Theory of elasticity Stress and strain, plane stress, plane strain, stress function, Theory of plasticity, yield stress, yield conditions (Mises & Tresca) Macroscopic failure mode, ideal fracture strength, energy release rate, Fracture Modes. **(7)**

2. **Fracture Criteria** :-
Griffith criterion, Irwin's Fracture Criterion, Stress Intensity Approach, Stress intensity factor, crack tip plasticity, crack opening displacement, plastic constraint. **(7)**

3. **Methods for Evaluating Fracture toughness:**-
   3.1 - Numerical Methods
      a. Finite Elements (FE)
      b. Finite Differences (FD)
      c. Boundary Integral Equations (BIE)

   3.2. Experimental Methods
      a. Compliance Method
      b. Photoelasticity
      c. Interferometry and Holography **(7)**

4. **Experimental evaluation of Fracture toughness:**- Plane strain fracture toughness, J – Integral **(7)**

5. **Fatigue mechanics:** - S-N diagram, fatigue limit, fatigue crack growth rate, Paris law. **(7)**

6. **Creep mechanics**: - Creep deformation, creep strength, creep-fatigue interaction. **(5)**

References :–

1. Anderson T.L., Fracture Mechanics, 2nd Edition, CRC Press, 1995
2. Hertzberg, R. W. *Deformation and Fracture Mechanics of Engineering Materials*. 4th ed. John Wiley & Sons, Inc., 1996.
3. ASTM standards

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.3 Elective II- THEORY AND ANALYSIS OF COMPOSITE MATERIALS

Teaching Scheme
Lectures: 3 Hrs per week
Tutorial: 1 Hrs per week

Examination Scheme:
Theory: 100 marks
TW: 25 Marks

1. Introduction to Composite Materials: Definition, Classification, Types of matrix materials and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Metal matrix composite, Particulate composites and Pre-pegs, Application of Composite Materials. **(5)**
2. Macro-mechanical behavior of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Stress – strain relations for Plane Stress in an Orthotropic Material, Strengths of an Orthotropic Lamina, Numerical problems. **(6)**
3. Micro-mechanical behavior of a Lamina: Introduction, Mechanics of Material approach to Stiffness, Elasticity approach to Stiffness, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems. Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsa-Hill theory, Tsai, Wu tensor theory, Numerical problems. **(8)**
4. Macro-mechanical behavior of Laminate: Introduction, code, Kirchoff hypothesis, Classical Lamination Theory, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Strength of Laminate, Inter-laminar Stresses. **(4)**
5. Manufacturing: Lay- up and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Types of defects, NDT methods. **(6)**
6. Bending, Buckling and Vibration of Laminated Plates: Introduction, Governing Equations for Bending, Buckling and Vibration of Laminated Plates. **(4)**
7. Other Analysis and Behavior of Composite Materials: Basic Principles of fracture mechanics and effect of discontinuity in laminates, applications. **(4)**
8. Introduction to Design of Composite Structures **(3)**

Term Work:
Eight assignments based on above syllabus

Reference Books:

1. Mechanics of Composite Materials, R.M. Jones, Taylor & Francis.
2. Mechanics of composite materials, Autar K. Kaw, CRC Press New York.
3. Composite Materials handbook, Mein Schwartz, Mc Graw Hill Book Company, 1984.

Reference Books:

1. Stress analysis of fiber Reinforced Composite Materials, Michael W, Hyer, Mc-Graw Hill International.
2. Composite Material Science and Engineering, Krishan K. Chawla, Springer.
3. Fiber Reinforced Composites, P.C. Mallik, Marcel Decker

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 5.4 Elective II- Engineering Design Optimization

Teaching Scheme
Lectures: 3 Hrs per week
Tutorial : 1 Hrs per week

Examination Scheme:
Theory: 100 Marks
TW: 25 Marks

1. **Introduction to Optimization:** Need for optimization and historical development, engineering application of optimization, Classification of optimization problems, Formulation and statement of optimization problems. **(4)**

2. **Classical Optimization Methods:** Introduction, Review of single and multivariable optimization techniques with or without constraints. **(5)**

3. **Linear Programming:** Standard form of linear programming, geometry of linear programming, solutions of system of linear simultaneous equations. **(6)**

4. **Non Linear Programming:** One dimensional minimization methods, elimination methods, unrestricted search, exhaustive search, golden section method. **(6)**

5. **Non Linear Programming (Unconstrained Optimization):** Direct search method, random search method, grid search method, indirect search method. **(5)**

6. **Non Linear Programming (Constrained Optimization):** Direct methods, random search method, sequential linear programming, sequential quadratic programming. **(4)**

7. **Optimization Design of Mechanical Systems:** Purpose and applications of optimum design, effect of manufacturing errors, characteristics of mechanical systems, selection of optimum configuration **(5)**

8. **Multi objective Optimum Design:** Concepts and methods, Genetic algorithms, weighted sum method, weighted minimum-maximum method, Global optimization concepts and methods for optimum design. **(5)**

Term Work
Minimum eight assignments/tutorials based on above syllabus.

Reference Books

1. Engineering Optimization – S.S.Rao
2. Optimization Theory and Applications – S.S.Rao
3. Optimization for Engineering Design – Kalyanmoy Deb
4. Optimization Concepts & Application in Engineering – Belgundu & Chandrupatla
5. Optimum Design – J.S.Arora
6. Applied Optimal Design – E.J.Jaug, J.S.Arora
7. Principles of Optimization Design – Papalambros & Wilde
8. Operations Research – D.S.Hira & Gupta

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: 6 Seminar II

Teaching Scheme	**Examination Scheme:**
Practical: 2 Hours / week	**TW: 25 marks**

Topic Selection: Topic should be based on the literature survey on any topic relevant to Design Engineering. At least five journal papers should be referred for topic selection. It is desirable that the selected topic may be leading to selection of a suitable topic of dissertation.

Report: Each student has to prepare a write-up of about 25to 50 pages. The report typed on A4 sized sheets and bound in the necessary format, should be submitted after approved by the guide and endorsement of the Head of Department. It is expected that a review paper based on literature review is to be presented at least in conference.

Seminar Delivery: The student has to deliver a seminar talk in front of the teachers of the department and his classmates. It is expected to invite external examiner for the seminar. Based on the quality of content, understanding of the candidate, and seminar delivery the Guide or external examiner shall do an assessment of the seminar.

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: In-plant Training

Teaching Scheme:
Practical: 1 Hour/ Week

Examination Scheme:
TW: 50 marks

In plant training for (full time) one month duration shall be undertaken and completed by the candidate during vacation after **Semester-II**. The report of this training shall be submitted in the prescribed format at the beginning of Part II **Semester-III**. It will be approved by the guide and endorsed by the Head of Department. It will be assessed for term work during Part II **Semester-I**, by the evaluation committee (*) appointed by the Principal/ Head of the Department.

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: MINI PROJECT

Teaching Scheme:
Practical: 4 Hour/ Week

Examination Scheme:
TW: 50 marks
Oral: 50 Marks

A Mini Project based on the subjects studied during Part-I **Semester-I** and Part-I **Semester-II**, shall be undertaken and completed by the candidate during vacation after Part-I **Semester-II**. The report of this project shall be submitted in the prescribed format at the beginning of Part II **Semester-I**. It will be approved by the guide and endorsed by the Head of Department. It will be assessed for term work during Part II **Semester-I**, by the evaluation committee (*) appointed by the Principal/ Head of the Department.

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M.E.-Mechanical (Design Engineering) Syllabus

Sub: DISSERTATION

Teaching Scheme:
Practical: 5 Hour/ Week

Examination Scheme:
Viva Voce: 100 Marks
TW: 200 marks

1. TOPIC SELECTION SEMINAR: Topic shall be based on topic of the Dissertation Work. It may include literature review, required theoretical input, study and comparison of various approaches for the proposed dissertation work. The candidate shall prepare a report of about 25 pages. The report typed on A4 sized sheets and bound in the prescribed format shall be submitted after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work by the evaluation committee(*) appointed by the Principal/ Head of the Department.

2. DISSERTATION PHASE I /Progress Seminar: It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations / experimental design etc. A report of the work shall be submitted after approval by the Guide and endorsement of the Head of Department to the evaluation committee (*) appointed by the Principal/Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any.

3. SYNOPSIS APPROVAL: The Head of the Department shall appoint a committee comprising of the Guide and two experts to review and approve the synopses before submitting them to the University for approval. The candidates shall submit the synopsis to the University authorities for approval in the prescribed format before the due date.

4. DISSERTATION PHASE II: The candidate shall submit the detailed report as per the synopsis approved by the university, of the dissertation work in the prescribed format after approval by the Guide and endorsement by the Head of the Department. It will be assessed for term work by the evaluation committee (*) appointed by the Principal/Head of the Department, for completion of the proposed work.

NOTES FOR DISSERTATION:

The dissertation work to be carried out individually commences in the Part III and extends through Part IV. The topic of dissertation work related should be related to the areas of Design Engineering/Mechanical applications. Applications of computer as a tool for design, analysis, optimization etc, various aspects of manufacturing, manufacturing planning /management, quality engineering, simulation of products / processes / mechanisms / systems, experimental study, etc. are to be encouraged and preferred in the work.