**Structure and syllabus of M.Tech Mechanical (Design Engineering) applicable w.e.f.**

A. Y. 2017-18

|  |  |  |
| --- | --- | --- |
| Sr.No. | Subject Code | Title |
|  |  | Course Structure |
| 1 | **Semester I** |
| 1.1 | ES552TH | Mathematical Methods in Mechanical Engg. |
| 1.2 | ME551THL | Advanced Stress Analysis |
| 1.3 | ME552THL | Vibration and Noise Control |
| 1.4 | ME553THL | Analysis and Synthesis of Mechanisms |
| 1.5 | ES502TH | Research Methodology |
| 1.6 | HS551TH | Quantitative Aptitude-I |
| 2 | **Semester II** |
| 2.1 | ME556THL | Advanced Machine Design |
| 2.2 | ME557THL | Computer Aided Engineering |
| 2.3 | HS553TH | Engineering Economics |
| 2.4 | HS552TH | Quantitative Aptitude-II |
|  |  | **Departmental Elective**  |
| 2.5 | ME561TH | Robotics |
| 2.6 | ME562TH | Industrial Tribology |
| 2.7 | ME563TH | Advance Manufacturing Methods |
| 2.8 | ME564TH | Vehicle Dynamics |
|  |  | **Open Elective** |
| 2.9 | ME571TH | Mechanics of Composite Material |
| 2.10 | ME572TH | Optimization Technique |
| 2.11 | ME573TH | Process Equipment Design |
| 3 | **Semester III** |
|  |  | **Dept. level Open Elective** |
| 3.1 | ME661TH | Reliability Engineering |
| 3.2 | ME662TH | Chassis and Body Engineering |
| 3.3 | ME614TH | Design of Experiments |
|  |  | **Institute level Open Elective** |
| 3.4 | HS66101 | Organizational Management |
| 3.5 | HS66102 | Business Economics |
| 3.6 | ME672PS/ME673PS | Technical Seminar  |
| 3.7 | ME675PRJ/ME676PRJ | Dissertation Stage I |
| 3.8 | ME671INT | Industrial in plant training |
| 4 | **Semester IV** |
| 4.1 | ME67703 | Dissertation Stage II |

|  |  |
| --- | --- |
|  | **Structure 2017-18 M. Tech. Mechanical (Design Engineering)** |
| Subject No. | Subject Code | Subject Name | Type | Teaching scheme (Hrs./week) | Assessment scheme | Total Mark | Credits |
| ISA | ISA | MSE | ESE |  |
| Lect | Practical | Breakup |
| CA | MSA | ESA |
|  | **Semester –I** |  |  |
| S1 | ES552TH | Mathematical Methods in Engineering | TH | 4 | - | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
| S2 | ME551THL | Advanced Stress Analysis  | THL | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
| S3 | ME552THL | Vibration and Noise Control  | THL | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
| S4 | ME553THL | Analysis and Synthesis of Mechanism | THL | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
| S5 | ES502TH | Research methodology | TH | 2 | - |  |  |  | 10 | 20 | 70 | 100 | 2 |
| S6 | HS551TH | Quantitative Aptitude-1 | TH  | 2 |  |  |  |  | 10 | 20 | 70 | 100 | 2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  | **20** |
|  |  | **Semester –II** |
| S7 | ME556THL | Advanced Machine Design  | THL | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
| S8 | ME557THL | Computer Aided Engineering | THL | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
| S9 | HS553TH | Engineering Economics | TH | 2 |  |  |  |  | 10 | 20 | 70 | 100 | 2 |
| S10 | HS552TH | Quantitative Aptitude-2 | TH  | 2 |  |  |  |  | 10 | 20 | 70 | 100 | 2 |
| S11 | **Department Elective**  | TH | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
|  | ME561TH | Robotics |  |  |  |  |  |  |  |  |  |  |  |
|  | ME562TH | Industrial Tribology  |  |  |  |  |  |  |  |  |  |  |  |
|  | ME563TH | Advanced Manufacturing Methods |  |  |  |  |  |  |  |  |  |  |  |
|  | ME564TH | Vehicle Dynamics  |  |  |  |  |  |  |  |  |  |  |  |
| S12 | **Open Elective**  | TH | 3 | 2 | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 4 |
|  | ME571TH | Mechanics of Composite Materials  |  |  |  |  |  |  |  |  |  |  |  |
|  | ME572TH | Optimization Technique  |  |  |  |  |  |  |  |  |  |  |  |
|  | ME573TH | Process Equipment Design |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  | **20** |
|  |  | **Semester –III (A)** |
| S13 | - | Dept. level Open Elective | TH | 3 |  | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 3 |
| S14 | - | Inst. level Open Elective | TH | 3 |  | 30 | 20 | 50 | 30 | 35 | 35 | 100 | 3 |
|  | ME672PS | Technical Seminar  |  | 2 |  |  |  |  | 10 | 20 | 70 | 100 | 2 |
| PS1 | ME675PRJ | Dissertation Stage I |  |  |  |  |  |  |  |  |  |  | 12 |
|  |  |  |  |  |  |  |  |  |  |  |  |  | **20** |
|  |  | **Semester –III (B)** |
| INT | ME671INT | Industrial in plant training  |  |  |  |  |  |  |  |  |  | 100 | 6 |
|  | ME673PS | Technical Seminar  |  | 2 |  |  |  |  | 10 | 20 | 70 | 100 | 2 |
| PS1 | ME676PRJ | Dissertation Stage I |  |  |  |  |  |  |  |  |  | 100 | 12 |
|  |  |  **Semester –IV** |
| PS2 | ME677PRJ | Dissertation Stage II |  |  |  |  |  |  |  |  |  | 100 | **20** |
|  | **Total** |  |  |  |  |  |  |  |  |  |  |  | **80** |

Dept. level Open Elective **Semester –III (A)**

|  |  |
| --- | --- |
| ME661TH | Reliability Engineering  |
| ME662TH | Chassis and Body Engineering |
| ME614TH | Design of Experiments |

Inst. Level open electives: **Semester –III (A)**

|  |  |
| --- | --- |
| HS66101 | Organizational Management |
| HS66102 | Business Economics |

**SEMESTER I**

**Title : Syllabus Format – PG Courses FF No. : 658**

**ES551TH/ES552TH: Mathematical Methods for Engineers**

**Credits: 04 Teaching Scheme: 4hrs / Week**

**Course Objectives:-**

1. The students will have a thorough knowledge of the mathematical methods to be applied to problems in Mechanical Engineering.
2. The students will effectively write code and use the algorithms for mathematical analysis with the help of any of the modern softwares.

**Course Outcomes:**

Students are able to:

1. Demonstrate understanding and make use of different mathematical methods employed to solve mechanical and chemical engineering problems.
2. Apply different methods and to various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. Apply different methods to model and represent various mechanical and chemical engineering systems.
4. Analyse, compare and evaluate the accuracy of common numerical methods..
5. Implement the various numerical methods in commonly used softwares like Matlab / Scilab / Octave / R / Spreadsheets.
6. Write efficient, well-documented code in any of the modern languages and present numerical results in an informative way.

**Unit 1:** Linear Algebra **( 6 Hrs)**

Vector spaces, Subspaces, Basis, dimension, System of linear equations, Gauss Elimination

**Unit 2:** Eigen Values and Eigen Vectors **( 6 Hrs )**

Eigen Values, Eigen Vectors, Diagonalization, Singular Value Decomposition

**Unit 3 :** Numerical methods **( 8 Hrs )**

Solution of system of linear equations by LU decomposition, Tridiagonal method, Gauss Seidel method, Eigen values by Power method, Newton Method for nonlinear systems, Splines interpolation

**Unit 4 :** Ordinary Differential equations **( 8 Hrs )**

Linear systems, classical methods, solution by diagonalization, adaptive numerical methods, implicit methods for stiﬀ systems.

**Unit 5 :** Variational Methods **( 6 Hrs )**

Rayleigh-Ritz and Galerkin methods, Introduction to FEM

**Unit 6 :** Partial Diﬀerential equations **( 6 Hrs )**

Elliptic equations (classical, iterative methods), parabolic(classical, numerical) and hyperbolic(analytical, numerical methods).

**Total Contact Hours: 40**

**Text Books:**

1. Applied Numerical Methods for Engineers and Scientists by S. S. Rao
2. Mathematical Methods in Chemical Engineering by S. Pushpavanam

**Reference Books:**

1. Numerical Methods for scientific and engineering computation: MK Jain, SRK Iyengar and RK Jain.
2. Mathematics of Physics and Engineering: IS Sokolnikoff and RM Redheffer.

|  |
| --- |
| **Title : Syllabus Format – PG Courses FF No. : 658** |
| **ME551THL: ADVANCED STRESS ANALYSIS** |
| **Credits: 04 Teaching Scheme: 3 hrs / Week****Lab: 2hrs/week** |
| **Course Objectives :** |
| 1. To introduce to students the Concept of three dimensional stress and strain at a point as well stress-strain relationships for isotropic materials.
2. To introduce to students the method of calculation of stresses in components of noncircular cross section subjected to unsymmetrical bending and torsional loading.
3. To introduce to students the method of calculation of shear stress in thin walled sections and determination of shear center.
4. To introduce to students the method of calculation of stresses and strains associated with thick wall cylindrical pressure vessels and rotating disks.
5. To introduce to student the methods of computing contact stresses.
 |
| **Course Outcomes :** |
| Students will be able to1. Understand the mathematical and physical foundations of the continuum mechanics of solids, including deformation and stress measures and constitutive relations.
2. Calculate stresses in open and closed sections under torsion and bending.
3. Analyze and provide solutions for problems concerning plastic deformation & collapse.
4. Analyze and provide solutions for problems concerning contact stresses.
5. analyze and provide solutions using modern engineering tools to solid mechanics problems & understand contemporary issues in solid mechanics research
6. comprehend current research findings as reported in journals in the field of solid mechanics
 |
| **Unit 1 Theory of elasticity (6 Hrs)** Plane stress & Plane strain, Two dimensional problems in Rectangular & Polar co-ordinate system, Analysis of stresses & strains in Three dimensions. |
| **Unit 2 Theory of torsion (6 Hrs)** Torsion of general prismatic bars of solid section, Membrane Analogy, Torsion of Thin walled tubes, Torsion of Thin walled Multiple-Cell closed sections, Torsion of rolled sections |
| **Unit 3 Bending of Prismatic bars, Unsymmetric and Plastic bending (8 Hrs)** Concept of shear centre in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section and closed section. The plastic flow process, shape factor, spring back, plastic bending with strain hardening material, plastic hinges, plastic deflection. |
| **Unit 4 Plate Bending (6 Hrs)** Bending of plate to cylindrical surface, Bending of a long uniformly loaded rectangular plate, pure bending in two perpendicular directions, Bending of circular plates loaded symmetrically w.r.t. center. Circular plate with circular hole at center symmetrically loaded & load distributed along inner & outer edges, Bending of circular plates of variable thickness. |
| **Unit 5 Pressurized Cylinders & Rotating Disks (8 Hrs)** Governing equations, stresses in thick walled cylinder under internal & external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength. |
| **Unit 6 Contact Stresses (6Hrs)** Geometry of contact surfaces, methods of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area. Introduction to analysis of low speed impact. |
| **Total Contact Hours : 40****Laboratory work.**1. Plate bending analysis using FEA
2. Contact Stress analysis of mechanical components
3. Determination of shear center for thin walled cellular structure and its FEA
4. Stress Analysis of IC engine components
5. Unsymmetrical Bending for different sections
6. Analysis of pressure vessels
 |
| **Text Books :** 1. Advanced strength and Applied stress analysis - Richard G Budynas, McGraw Hill 2. Advanced Mechanics of solids - L S Srinath , McGraw Hill  |
| **Reference Books** 1. Advanced Mechanics of Materials - Cook and Young , Prentice Hall 2. Theory of elasticity - Timoshenko and Goodier , McGraw Hill 3. Advance Strength of Materials- vol 1 & 2 – Timoshenko, CBS publisher 4. Advanced Mechanics of Materials – Boresi, Schmidt, Sidebottom, Willey 5. Mechanics of Materials - vol 1 & 2 - E J Hearn , Butterworth- Heinemann  |

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME552THL: Vibrations and Noise Control**

**Credits: 04 Teaching Scheme: 3 hrs / Week**

 **Lab: 2 hrs/ Week**

**Course Objectives:**

1. To enable students to solve field problems and applications
2. To enable students to appreciate the computational and analytical procedures used the design of vibration equipments.

**Course Outcomes:**

1. Students will be able to set up initial-boundary value problems.
2. Students will be able to determine analytical and numerical soloution for various loading and boundary conditions.
3. Students will be able to develop linear vibratory models of dynamic systems with changing complexities.
4. Students will understand vibration measurement and vibration isolation techniques.
5. Students will understand basics on noise measurement and analysis.

**Unit 1 :Transient Vibrations (6 Hrs)**

Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel’s) integral, impulse response function.

**Unit 2 :Multi degree of freedom systems (8 Hrs)**

Free, damped and forced vibrations of two degree of freedom systems, beat phenomenon, multi degree of freedom systems, matrix formulation, stiffness and flexibility influence coefficients, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange’s equations to derive the equations of motion.

**Unit 3 :Continuous Systems (8 Hrs)**

Vibrations of strings, bars, shafts and beams, discredited models of continuous systems and their solutions using Rayleigh – Ritz and Galerkin methods, use of Lagrange’s equation. Mode summation method.

**Unit 4 :Vibration and Shock Control (6 Hrs)**

Methods of vibration control, undamped / damped vibration absorbers, vibration dampers and isolators. Helmet design fundamentals.

**Unit 5 :Self-excited vibrations (4 Hrs)**

Only introduction, examples of self-excited vibrations like tool-chatter phenomenon, etc

**Unit 6 :Introduction to Shock and Noise (8 Hrs)**

Nonlinear vibrations, random vibrations. Theory of sound and noise Fundamentals of Noise measurement. Noise control and pollution norms. Noise free environment design.

**Total Contact Hours: 40**

**Lab wok :**

1. Using Impact Hammer to find the natural frequency
2. Using Shaker to find the Frequency Response
3. Whirling of Shafts - Model as a continuous system
4. 1-d modal analysis using ANSYS
5. 2d modal analysis of plates
6. Forced Vibration analysis



**Text Books:**

1. Theory of vibrations with applications: W.T. Thomson, CBS Publishers, Delhi.
2. Mechanical Vibrations: S.S. Rao, Addison – Wesley Publishing Co.

**Reference Books:**

1. Fundamentals of vibrations: Leonard Meirovitch, McGraw Hill International Edition.
2. Principles of Vibration Control: Asok Kumar Mallik, Affiliated East-West Press.
3. Mechanical Vibrations: A.H.Church, John Wiley and Sons, Inc.
4. Vibrations and Noise Control - By K Pujara
5. Schaum Series Problems in Vibrations

**Title: Syllabus Format – PG Courses FF No. : 658**

**ME553THL: Analysis and Synthesis of Mechanisms**

**Credits: 04 Teaching Scheme: 3 hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

1. Study the kinematic design variables of mechanisms
2. Study the kinematic analysis of complex mechanisms
3. Study the dynamic analysis of mechanisms
4. Apply kinematic theories in synthesis and design of the real-life mechanisms

**Course Outcomes:**

Students will have the ability to:

1. Understand construction and design parameters of mechanisms
2. Analyze the simple and complex mechanisms for kinematics & dynamics
3. Analyze mechanisms for their performance in terms of motion, path and body guidance.
4. Design and synthesize the mechanisms in real life applications
5. Use modern engineering tools in the analysis and design of mechanisms.

|  |  |  |
| --- | --- | --- |
| **Unit I**  | **Introduction:** Basic definitions, criterions, degree of freedom, construction of mechanisms, applied mechanisms and equivalent linkages. Mechanical advantage and transmission angle. Review the methods of kinematic analysis. Concept of mechanism synthesis and types.  | **(06 Hrs)**  |
| **Unit II**  | **Kinematic Analysis of Complex Mechanisms:** Complex mechanisms, degree of complexity, velocity and acceleration analysis of complex mechanisms by normal acceleration method, auxiliary point method and Goodman method.  | **(07 Hrs)**  |
| **Unit III**  | **Force Analysis of Planar Mechanisms:** Static force analysis, constraint and applied forces, static equilibrium. Dynamic force analysis of planar mechanisms, inertia forces linkages, Kineto-static analysis of mechanisms by matrix method. Analysis of elastic mechanisms, elastic linkage model, equations of motions.  | **(06 Hrs)**  |
| **Unit IV**  | **Analytical synthesis of Planar Mechanisms:** Type, number and dimensional synthesis, function generation, path generation and rigid body guidance, accuracy (precision) points, Chebychev Spacing, Freudenstein’s equation, displacement, velocity and acceleration equations. Synthesis of four-bar function generator and slider- crank mechanism, Complex number method of synthesis. Four and five accuracy point synthesis, errors in linkages.  | **(07 Hrs)**  |
| **Unit V**  | **Graphical Synthesis of Planar Mechanisms:** Graphical synthesis for function generation, rigid body guidance and path generation. Synthesis with two, three and four accuracy points using pole method, center point and circle point curves, Branch and order defects, Synthesis of coupler curves, Robert Chebychev theorem, Cognate mechanisms. | **(07 Hrs)**  |
| **Unit VI**  | **Curvature Theory:** Fixed and moving centrodes, inflection circle, Euler- Savy equation, Bobillier constructions, cubic of stationary curvature, Ball’s point, Applications in dwell Mechanisms **Kinematic Analysis of Spatial Mechanisms :** Denavit- Hartenberg parameters, matrix method of analysis of spatial mechanisms.  | **(07 Hrs)**  |

**Total Contact Hours: 40**

**Laboratory /project work**

1. Positional analysis of planar mechanisms
2. Kinematic analysis of complex mechanisms.
3. Dynamic Analysis of planar mechanisms
4. Graphical and Analytical Synthesis.
5. Curvature analysis

**Text Books:**

1. Theory of Machines and Mechanisms, A. Ghosh and A.K.Mallik, Affiliated East- West Press

2. Theory of Machines and Mechanisms, J. E. Shigleyand J. J. Uicker, 2nd Ed., McGraw-Hill

**Reference Books:**

1. Kinematic Synthesis of Linkages, R. S. Hartenberg and J. Denavit, McGraw-Hill

2. Mechanism Design - Analysis and Synthesis (Vol.1and 2), A. G. Erdman and G. N. Sandor, Prentice Hall of India

3. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L.Norton, Tata McGraw-Hill, 3rd Edition.

4. Kinematics and Linkage Design, A.S.Hall, Prentice Hall of India

**Title: Syllabus Format – PG Courses FF No. : 658**

**ES502TH: Research Methodology**

**Credits: 02 Teaching Scheme: 2hrs / Week**

**Course Objectives:**

1. To understand the concept and distinct types of engineering and science research
2. To understand the research process in detail in terms of ideation, concept, design and implementation of research.
3. To develop expertise in studying, writing and presenting technical documentation such as papers, thesis, etc.
4. To understand and get exposed to different tools and techniques essential for research

**Course Outcomes:**

1. Perform research in a more organized and efficient manner
2. Choose ideal method to select problem statement, design the research, collect and analyze data and test the hypothesis
3. Efficiently read and summarize technical documentation
4. Systematically write, publish and present technical documentation
5. Understand legal issue regarding research
6. Be aware of and use searching, documenting and presenting tools and technologies

**Unit1: Formulating Research Problem and Literature Review (9 Hrs)**

**Overview:** RE-Search, Definition, Research characteristics, Difference between methods and methodology, Research categories, Overview of research process.

**How to get new research ideas:** Creating thinking, Preparations for improving thinking

**Defining research problem statement:** Need, What is a research problem, Sources of research problem, research problem components

**Literature Survey Overview:** What is literature survey, Types of literature survey, Sources of information, Types of technical papers,

Publication and patent databases, How to read a scientific paper, How to write scientific paper**,** writing technical papers in English – Grammar, Punctuation, Tips for writing correct English, How to write a research proposal, How research is funded, How to give a good research talk, Presentation tools

**Research Ethics and Legal Issues**: Intellectual Property rights, Patents, Copyrights,

Plagiarism

**Unit 2: Research Design and Data Collection (6 Hrs)**

**Research Design:** What is research design, Research Design Parts, Research Design for exploratory and Descriptive Research, Principals of Research design.

**Sampling Design:** Steps in sampling Design, Different Types of Sample Design

**Unit 3: Data Collection and Analysis (6 Hrs)**

**Methods of data collection:** Data types, Data Collection Types: Observation, Interview,

Questionnaire, Schedules, Collection of Secondary Data

**Analysis and Processing of Data:** Processing operations, Types of Analysis, statistics in

Research, Measures of central Tendency, Measures of Dispersion, Measures of Asymmetry, Measures of Relationship, simple regression Analysis, Multiple correlation and regression, association in case of attributes

**Unit 4: Hypothesis testing (9 Hrs)**

**Defining Hypothesis:** What is hypothesis, Characteristics of hypothesis, Hypothesis Vs

Problem Statement

**Hypothesis Testing:** Null hypothesis, Alternative Hypothesis, Level of significance,

Type I and Type II Errors, One tailed and two tailed hypothesis, Power of hypothesis tests

**Parametric Tests:** z-test, t-test, chi-square test, F-test, ANOVA

**Total Contact Hours: 30**

**Text Books:**

1. ‘Research Methodology: Methods and Trends’, , by Dr. C. R. Kothari, 2nd revised edition, New Age International Limited Publishers, ISBN: 978-81-224-1522-3

2. ‘Research Methodology: An Introduction’ by Wayne Goddard and Stuart Melville, 2nd

 Edition, Juta and Co. Ltd, ISBN: 0-70215660-4

**Reference Books:**

1. ‘Research Methodology: A Step by Step Guide for Beginners’, by Ranjit Kumar, 2nd

 Edition, APH Publishing Corporation

2. ‘Research methodology: an introduction for science & engineering students’, by Stuart

 Melville and Wayne Goddard

3. ‘Research Methodology’ by Dr. Jayant Tatke, 2009, Symbiosis Centre for Distance

 Learning

4. ‘Operational Research’ by Dr. S.D. Sharma, Kedar Nath Ram Nath & Co

5. Online material provided by the faculty

**Title: Syllabus Format – PG Courses FF No. : 658**

**HS551TH: Quantitative Aptitude-I**

**Credits: 02 Teaching Scheme: 2hrs / Week**

|  |  |
| --- | --- |
| **Unit 1: Numbers, Surds and Indices & Logarithms** | **(7 Hours)** |
| Numbers, Average, Decimal fractions, Problem on ages, Simplification, Problems on numbers, Square roots & cube roots, Logarithms, Surds and Indices, HCF and LCM of Numbers. |
|  |
| **Unit 2: Time ,distance and work** | **(7 Hours)** |
| Time and distance, Problems on trains, Boats and Streams, Time and Work , Pipes and Cisterns, Alligation or mixture |
|  |
| **Unit 3: Measures of Statistical Data** | **(7 Hours)** |
| Percentage, Profit and loss, Ratio and Proportion, Simple interest, Compound interest, Partnership, Chain Rule. |
|  |
| **Unit 4: Logical Reasoning**  | **(7Hours)** |
| Race and Games , Odd Man Out and Series, Number Series, Analogies, Logical Problems, Letter and Symbol Series, Statement and Conclusion, Artificial Language |
|  |
|  |
| **Text Books** 1. Quantitative Aptitude For Competitive Examinations”, Dr. R. S. Aggarwal, S. Chand.
2. “How to Prepare for Quantitative Aptitude”, Arun Sharma, Tata Mcgraw-Hill.

**Reference Books** 1. Quantitative Aptitude Quantum Cat Common Admission Test”, K. Sarvesh Verma., Arihant.
2. “Quantitative Aptitude for Competitive Examinations”, Abhijit Guha, Fourth Quarter.
 |

**Course Outcomes**

The students will be able to:

1. improve their employability skills
2. improve aptitude, problem solving skills and reasoning ability
3. critically evaluate various real life situations by resorting to analysis of key issues and factors.
4. demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions

**SEMESTER II**

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME556THL: Advanced Machine Design**

**Credits: 04 Teaching Scheme: 3 hrs / Week**

**Lab: 2hrs/week**

**Objectives**

* + 1. Study advance design concepts in order to enhance the basic design of cam, gear, and springs in various applications
		2. Analysis and design of mechanical components under fatigue and creep loading conditions
		3. Study statistical techniques and applications in mechanical design.

**Outcomes:**

Students will have the ability to:

1. Analyze basic design critically for further improvements
2. Formulate and solve design problems of mechanical systems related to gear profile, cam dynamics and springs etc.
3. Design and optimization of mechanical components to meet desired engineering requirements including strength, dynamics and life under different conditions such as fatigue and creep
4. Apply knowledge of statistical techniques to mechanical design problems
5. Use modern engineering tools in the analysis and design of machine components.

**UNIT 1 : CAMS (6 hrs)**

Advanced curves: 2-3 polynomial, 3-4-5 polynomial, 4-5-6-7 polynomial & higher order polynomial. Polydyne cams: 3-4-5 cam, cycloidal cam. Pressure angle, radius of curvature, force on follower and cam, cam design with elasticity of part is considered, ramps.

**UNIT 2 : GEARS (8 hrs)**

Dynamic load, constants of the dynamic system, contact stresses in gears, profile modification, extended centre distance system of gearing, long and short addendum gearing, backlash, undercutting .

**UNIT 3 : SPRINGS (6 hrs)**

Helical springs under static and fatigue or variable loading, buckling of helical compression spring, vibration and surging of helical springs, Optimum design of helical spring.

Design analysis of Belleville springs, ring spring, volute spring, rubber springs and mountings.

**UNIT 4 : DESIGN AGAINST FATIGUE (8 hrs)**

Fatigue Damage theories, Cycle counting Techniques, Stress based fatigue Analysis & design: one dimensional analysis, multiaxial analysis, Cumulative damage. Strain based fatigue Analysis & design: one dimensional analysis, multiaxial analysis .Surface integrity & fatigue life improvement.

**UNIT 5 : DESIGN AGAINST CREEP (6 hrs)**

True stress and true strain, creep of material at high temperature, creep parameters, exponential creep law, hyperbolic sine creep law, etc. Estimated time to rupture, correlation of creep-rupture data, stress relaxation, creep in bending, etc. materials for application at elevated temperatures.

**UNIT 6: ENGINEERING STATISTICS (6 hrs)**

Analysis of variance (ANOVA), factorial design and regression analysis, Reliability theory, design for reliability, Hazard analysis, fault tree analysis.

**Total Contact Hours: 40**

**Laboratory work**

1. Dynamic analysis of cam follower mechanism
2. Contact Stress analysis of Gear
3. Parametric study and analysis of mechanical springs
4. Fatigue analysis of mechanical components
5. Creep analysis of mechanical components
6. Statistical design consideration & analysis

**Text Books :**

* 1. Mechanical Design Analysis – M.F. Spotts , Prentice Hall
	2. Mechanical Springs – A.M. Wahl, first edition; Cleveland: Penton Pub. Co.

**REFERENCE BOOKS**

1. CAMS: design, dynamics, and accuracy – H.A. Rothbart, Wiley
2. Fatigue Design: life expectancy of machine parts –EliahuZahavi&ValdimirTorbilo, CRC Press
3. Machine Design – Robert Norton, Prentice Hall

|  |
| --- |
| 1. Handbook of Practical Gear Design – D W Dudley, McGraw-Hill Companies
2. Cam design handbook H.A. Rothbart, McGraw-Hill, 2004
 |

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME557THL : Computer Aided Engineering**

**Credits: 04 Teaching Scheme: 3 hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

1. Understand the fundamental ideas of the solid modeling.
2. Understand the fundamental ideas of the FEM and Computational Fluid Dynamics
3. To interpret and evaluate the quality of the results. Be aware of the limitations of the FEM.
4. Learn how the finite element method is implemented (both algorithmically and numerically) by developing simple finite element computer code
5. Develop finite element formulations of engineering problems from a variety of application areas including stress, heat transfer, and vibration analysis.

**Course Outcomes:**

Students will be able to:

1. Understand the mathematical formulation of the finite element and to apply it to basic (linear) ordinary and partial differential equations
2. Model and simulate complex engineering problems by proper selection of finite element and boundary conditions.
3. Solve linear, nonlinear and dynamic analysis problems using 1D, 2D and 3D FE models.
4. Solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering all necessary factors.

**Unit 1: Solid Modeling (7 hrs.)**

Geometry & Topology, Solid representation, Techniques of volume modeling, Feature based modeling: Feature representation, Parametrics, Relations, Constraints, Feature Manipulation. Assembly modeling and analysis, Product Data Exchange.

**Unit 2: One dimensional Finite Element Analysis (7 hrs.)**

Linear bar element, Quadratic bar element, beam element, frame element. Development of Finite Element Models of discrete systems like Linear elastic spring, Torsion of Circular Shaft, Fluid flow through pipe, One dimensional conduction with convection.

**Unit 3: Two dimensional Finite Element Analysis**  **(7 hrs.)**

Three noded triangular element, six noded triangular element, four noded quadrilateral element, eight noded quadrilateral element and nine noded quadrilateral element. Development of Finite Element Models for plane stress, plane strain, Axisymmetric stress analysis applications.

**Unit 4: Dynamic Analysis Using Finite Elements** **(7 hrs.)**

Vibration problems, Equations of motion based on weak form, Equations of motion using Lagrange’s approach, consistent and lumped mass matrices, Solution of Eigenvalue problems, Transient vibration analysis.

**Unit 5: Computational Flow Simulation (5 hrs.)**

Meshing for flow simulation, finite volume methods, pressure-velocity coupling, numerical stability.

**Unit 6: Three dimensional Finite Element Analysis (7 hrs.)**

Four node tetrahedral element, six node prism element, Eight node Hexahedral element and higher order elements. Boundary conditions, Mesh Generation, Mesh Refinement and other practical considerations.

**Total Contact Hours: 40**

**Laboratory work**

1. Finite Element Analysis of 2D , 3D problems using commercial FEA Software
	1. Gear tooth analysis
	2. Crane Hook analysis
	3. Plate with hole & study of stress concentration
	4. Pressure Vessel stress Analysis
	5. Connecting Rod, Crank Shaft, Cam Shaft stress Analysis.
2. Flow Simulation: Flow through pipes, flow over bodies.
3. Computer Implementation of 2-D Problems.

**Text Books:**

1. Ibrahim Zeid, ‘Mastering CAD/CAM’, Tata McGraw Hill Co. Ltd. 2007
2. Larry J. Segerlind, ‘Applied Finite Element Analysis’, John Wiley & Sons, New York, 1984.
3. T Sundararajan and K Muralidhar, ‘Computational Fluid Flow and Heat Transfer’, Alpha Science International, Ltd., 2003.
4. T R Chandraupatla, A D Belegundu, ‘Introduction to Finite Elements in Engineering’, Pearson Education, 3rd Ed. 2004.

**Reference Books:**

1. D F Roger, J Adams, ‘Mathematical Elements for Computer Graphics’, McGraw Hill Co. Ltd. New York, 1990.
2. J N Reddy, ‘Introduction to Finite Element Method’ , Tata McGraw Hill Co. Ltd, 2005
3. K H Huebner, D L Dewhirst, D E Smith, T G Byrom, ‘The Finite Element Method for Engineers’, John Wiley & Sons, New York, 2008.
4. P. Sheshu, Textbook of Finite Element Analysis, Prentice Hall of India, 2004.

**Title : Syllabus Format – PG Courses FF No. : 658**

**HS553TH : Engineering Economics**

**Credits: 02 Teaching Scheme: 2hrs / Week**

**Title: Syllabus Format – PG Courses FF No. : 658**

**HS552TH: Quantitative Aptitude-II**

**Credits: 02 Teaching Scheme: 2hrs / Week**

|  |  |
| --- | --- |
| **Unit 1: Area, Volume, Permutation and Combinations** | **(7 Hours)** |
| Area, Volume and Surface Areas, Calendar, Clocks, Permutations and Combinations, Probability, Heights and Distances. |
|  |
| **Unit 2: Data Interpretation** | **(7 Hours)** |
| Tabulations: Tabulations of Imports and Exports of Data, Analysis of Tabulated Data, Bar Graphs: Vertical or Horizontal Bars, Pie Charts: Pie Graphs, Central angle, Line Graphs. |
| **Unit 3: Probability** | **(7 Hours)** |
|  Introduction to probability, Structure of probability, Results of probability, Revision of probability: BAYES’ RULE, and examples; Random variable and probability distribution: Discrete and Continuous distribution, Expected value and variance of a distribution. |
|  |
| **Unit 4: Correlation & Regression Analysis** | **(7 Hours)** |
| Regression analysis (Linear only), Correlation analysis, Karl Pearson’s correlation coefficient, Spearman’s Rank correlation coefficient |
|  |
|  |
| **Text Books** 1. Quantitative Aptitude For Competitive Examinations”, Dr. R. S. Aggarwal, S. Chand. 2. “How to Prepare for Quantitative Aptitude”, Arun Sharma, Tata Mcgraw-Hill. 3. Probability & Statistics for Engineers- Richard Johnson – Prentice Hall of India, 4. Statistics for Management- Richard Levin , Rubin - Prentice Hall of India, **Reference Books** 1. Quantitative Aptitude Quantum Cat Common Admission Test”, K. Sarvesh Verma., Arihant.
2. “Quantitative Aptitude for Competitive Examinations”, Abhijit Guha, Fourth Quarter.
 |

**Course Outcomes**

The students will be able to:

1. improve their employability skills
2. improve aptitude, problem solving skills and reasoning ability
3. critically evaluate various real life situations by resorting to analysis of key issues and factors.
4. demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME561TH: Robotics**

**Credits: 04 Teaching Scheme: 3 hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

This course provides an in-depth coverage of the central topics in robotics, namely geometry, kinematics, differential kinematics, dynamics, and control of robot manipulators.

**Course Outcomes**: At the end of the course, students will

1. understand the basic concepts of robotics including kinematics, dynamics, actuators, controllers, etc;
2. Implement robot control algorithms, both open loop and closed loop
3. Understand the different sensors used in robotics
4. Understand the End Effectors used in robotics

**Unit-I (7 Hrs)**

**Robot Fundamentals:-**

Definitions, History of robots, present and future trends in robotics, Robot classifications, Robot configurations, Point to Point robots, Continuous Path robots, Work volume, Issues in design and controlling robots Repeatability, Control resolution, spatial resolution, Precision, accuracy, Robot configurations, Point to Point robots, Continuous Path robots, Work volume, Applications of robots.

**Unit-II (7 Hrs)**

**Manipulator Kinematics:-**

Matrix Algebra, Inverse of matrices, rotational groups, matrix representations of coordinate transformation, transformation about reference frame and moving frame Forward & Inverse Kinematics examples of 2R, 3R & 3P manipulators, Specifying position and orientation of rigid bodies Euler’s angle and fixed rotation for specifying position and orientation Homogeneous coordinate transformation and examples D-H representation of kinematics linkages Forward kinematics of manipulators using D-H representations Inverse kinematics of manipulators using D-H representations, Inverse Kinematics geometric and algebraic methods

**Unit-III (7 Hrs)**

**Robotics Dynamics:-**

Velocity Kinematics, Acceleration of rigid body, mass distribution Newton’s equation, Euler’s equation, Iterative Newton –Euler’s dynamic formulation, closed dynamic, Lagrangian formulation of manipulator dynamics, dynamic simulation, computational consideration.

**Robot Controllers:-**

Essential components-Drive for Hydraulic and Pneumatic actuators, Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, issues in nonlinear control, force feedback, hybrid control.

**Unit-IV (5 Hrs)**

**Trajectory planning:-**

Introduction, general considerations in path description and generation, joint space

schemes, Cartesian space schemes, path generation in runtime, planning path using

dynamic model point to point and continuous trajectory , 4-3-4 & trapezoidal velocity strategy for robots.

**Unit –V (7 Hrs)**

**END EFFECTORS:** Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

**Robot Sensors:-**

 Internal and external sensors, position- potentiometric, optical sensors ,encoders - absolute, incremental ,touch and slip sensors velocity and acceleration sensors, proximity sensors, force & torque sensors,.

**Robot Vision:-**

Camera model and perspective transformation, image processing fundamentals for robotic applications, image acquisition and pre-processing..

**Unit VI (7 Hrs)**

**ROBOT APPLICATIONS:** Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

**Robot Programming languages:-**

Introduction the three level of robot programming, requirements of a robot programming language, problems peculiar to robot programming. Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations.

**Futuristic topics in Robotics:-**

Micro-robotics and MEMS (Microelectrode mechanical systems), fabrication technology for Micro-robotics, stability issue in legged robots, under-actuated manipulators.

**Total Contact Hours: 40**

**Laboratory work**

1. Simulation of reverse kinematics using commercial software
2. Simulation of trajectory planning with commercial software robotics toolbar
3. Simulation of Forward kinematics using commercial software.

**Text books:**

1. Industrial robotics MikellP.Groover McGraw Hill.
2. Robotics / K.S.Fu / McGraw Hill
3. J.J.Craig , introduction to Robotics , Addision-wesely 1989

**Reference Books:**

1. S.R.Deb, “Robotics Technology and Flexible Automation“, Tata Mc Graw Hill 1994.
2. M.P.Groover, M. Weiss R.N. Nagel, N.G. Odrey “Industrial Robotics (Technology ,
3. Programming and application s) , McGraw, Hill 1996
4. J.J.Craig , introduction to Robotics , Addision-wesely 1989.
5. Klafter , Richard D., et al “ Robotics Engineering”,PhI,1996.
6. Zuech,Nello,”Applying Machine Vision “,john Wiley and sons, 1988
7. R.K.Mittal and I J Nagarth .,Robotics and control , Tata McGrawhill,2004

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME562TH : Industrial Tribology**

**Credits: 04 Teaching Scheme: 3hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

1. To provide the theoretical and practical knowledge of friction, wear and lubrication process.
2. To learn about tribological modeling and simulation.
3. To create an awareness of the importance of tribology in design and selection of machine elements.

**Course Outcomes**:

 Students will be able to-

1. apply the basic theories of friction, wear to predictions about the frictional behavior of commonly encountered sliding interfaces.
2. develop mathematical model of fluid film bearings
3. apply analytical and numerical techniques to design fluid film bearings

**Unit 1 : Friction and wear (5 Hrs)**

Theories of friction, types of wear, metals and non-metals.

**Unit 2 :Lubrication of bearings (6 Hrs)**

Mechanics of fluid flow, Reynold’s equation; application to infinitely long bearings, slider bearing, journal bearings, finite bearings.

**Unit 3 : Hydrodynamic and hydrostatic bearings (6 Hrs)**

Hydrodynamic squeeze film bearings, hydrostatic bearings.

**Unit 4 :Gas lubricated bearings (6 Hrs)**

Long slider bearings, finite journal bearings, foil bearings.

**Unit 5 :Elasto-hydrodynamic lubrication (6 Hrs)**

Principles and applications, Hetrz contact stress theory, Ertel-Grubin equation, different regimes in EHL, EHL point and line contact.

**Unit 6 : Rolling element bearings (7 Hrs)**

Ball bearings, roller bearings, load capacity, lubrication.

**Total Contact Hours: 36 Hrs.**

**Laboratory work:**

1. Simulation of finite journal/slider bearing (Hydrodynamic lubrication) with programming software.
2. Simulation of Elasto-hydrodynamic lubrication (point and line contact) with a programming software.
3. Experiment on hydrodynamic lubrication for journal bearings.
4. Pin on disc experiment
5. Experiment on four ball test

**Text Books:**

1. Introduction to Tribology of bearings: B.C Majumdar, S. Chand and company ltd. New Delhi (2008)
2. Engineering Tribology: PrasantaSahoo, Prentice Hall of India, New Delhi (2005)

**Reference Books :**

1. Basic Lubrication Theory: A. Cameron
2. The principles of lubrication: A. Cameron. Longmans Green & Co. Ltd.
3. Theory of Lubrication: B. C. Majumdar, M. Sarangi, M. K. Ghosh, Tata McGraw Hill Education, (2013).
4. Fundamentals of Friction and wear of Materials: American Society of Metals.
5. The Design of Aerostatic Bearings: J.W. Powell.
6. Gas Bearings: Grassam and Powell.
7. Theory of Hydrodynamic Lubrication: Pinkush and Sterrolicht.
8. Engineering Tribology: G. W Stachowiak, , A. W. Batchelor, Boston: Butterworth-Heinemann, 2001.

**Title: Syllabus Format – PG Courses FF No. : 658**

**ME563TH: Advanced Manufacturing Methods**

**Credits: 04 Teaching Scheme: 3hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

1. To know advancements in various advanced manufacturing methods.
2. To provide students with an understanding of advanced and emerging manufacturing technologies and also to learn the skills needed to implement these technologies in modern global and local industries.

**Course Outcomes:**

1. To give the students the in-depth understanding of mechanics of metal forming.
2. Students will be able to understand laser based machining which will be applied in the industry resulting in precision working.
3. To understand the principle, various process parameters and mechanism of metal removal of micromachining processes.
4. To understand appropriate levels of the principles of additive manufacturing from CAD design to part manufacture, also they will get knowledge about the surface processes.
5. To give students an overview of contact and noncontact inspection methods used for measurement of micro-machined components.
6. Students will learn about Production machines: NC, CNC, and DNC.

**Unit 1: Metal Forming (6 Hrs)**

Introduction, Strain, stress, Mohr’s circle, Yield criteria, Comparison of yield criteria, work of deformation, deformation theory, Levy Von-Mises flow rules. Forging practices and operations. Slab method of analysis, open die forging pressure and force analysis.

**Unit 2:Laser Based Machining (6 Hrs)**

Basics of lasers covering fundamentals of laser operation, their variety, optical components, beam delivery and properties of focused radiation. Components of industrial laser systems, including motion systems and beam delivery systems. Laser materials processing covering the interaction of a laser beam with materials, phase changes produced and why some lasers are better at processing some materials than other lasers. Industrial applications of lasers including laser cutting, laser welding, laser surfacing, laser marking and laser drilling.

**Unit 3:Micro Machining (8 Hrs)**

Machining for Micro devices, various methods of micromachining like Micro EDM, Micro ECM, Ultrasonic, Lithography, Beam machining processes: LBM, IBM, and EBM.

**Unit 4: Material Additive Processes (8 Hrs)**

Advanced welding processes, Advanced surface coating processes, Rapid prototype manufacturing.

**Unit 5: Measurement systems for Micromachining (6 Hrs)**

Fundamentals of measurement, uncertainty of measurement, calibration; Sensors; Non-contact inspection methods: ultrasonic, computer vision, laser-based interferometry, Tactile inspection: Coordinate Measuring Machines (CMM), mechanical arms; Intelligent systems: components, benefits and applications. Devices, instruments used for micro machined components.

**Unit 6: NC/CNC/DNC Machine (6 Hrs)**

Introduction, Components Part programming languages, recent developments.

**Total Contact Hours: 40**

**Laboratory works:**

1. Study and demonstration of rapid prototyping machine.
2. Simulation of wire drawing process on FEA software.
3. Simulation of manufacturing process on CAE software

**Text Books:**

1. Manufacturing Science, Amitabha Ghosh and Asok Kumar Mallik, 2nd Edition, East-West Press Pvt. Ltd.
2. Introduction to Micromachining, V K jain, Narosa Publishing House
3. P. N. Rao, “CAD/CAM Principles and Applications”;2002, tata McGraw Hill Publishing Company Limited
4. Chua Chee Kai, Leong Kah Fai, Lim Chu -Sing, Rapid Prototyping: Principles and Applications, 2 nd edition, World Scientific, 2003, ISBN: 9812381201.

**Reference Books:**

1. Fundamentals of Metal Forming processes, B L Juneja, New Age Publishers.
2. P. C. Pandey and H. S. Shan, Modern Machining Processes, Tata McgrawHill,New
3. Delhi, 2003.
4. P. K. Mishra, Nonconventional machining, Narosa publishing house, 2011
5. G. Benedict, Nontraditional manufacturing processes, Marcel Dekker, New York, 1st Edition, 1987.
6. J. A. McGeough, Advanced methods of machining, Chapman & Hall, London, 1st Edition, 1988

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME564TH: Vehicle Dynamics**

**Credits: 04 Teaching Scheme: 3hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

* + 1. To give the student knowledge about modelling and analysis of vehicle’s dynamic behavior.
		2. To explain concepts in vehicle control relating to traction/braking, handling/steering, and suspension
		3. To create a vehicle model and analyse the same.

**Course Outcomes:**

* + 1. Students will be able to understand dynamics and performance parameters of the components related to the vehicle handling.
		2. Students will be able to analyze vehicle performance criteria
		3. Students will be able to understand vehicle models and analyze dynamic response of the vehicle.
		4. Students will be able to understand dynamics of steering mechanism
		5. Students will be able to understand dynamics of suspension

**Unit 1 : Mechanics of Pneumatic tires ( 4 Hrs)**

Tire construction, Tire forces and Moments,rolling resistance, tractive efforts, cornering properties ride properties

**Unit 2 : Performance characteristics of road vehicles (7 Hrs)**

Equations of motion, aerodynamic forces / moments, transmission characteristics, vehicle performance, braking performance

**Unit 3 : Handling characteristics (10 Hrs)**

Steering geometry, steady state handling, testing of handling characteristics , directional stability

**Unit 4 : Vehicle ride characteristics ( 7 Hrs)**

 Human response, vehicle ride models, vehicle response

**Unit 5 : Suspensions (7 Hrs)**

Axles , independent suspensions , suspension geometry , roll centre analysis , rubber and air suspensions

**Unit 6 : Steering system (5 Hrs )**

Steering geometry , steering forces and moments , steering system models

**Total Contact Hours: 40**

**Laboratory work:**

1. Analysis of vehicle test data for steady state cornering.
2. Analysis of vehicle test data for transient cornering.
3. Simulation of vehicle quarter car model for handling characteristics

**Text Books:**

1. Gillespie T, D. ,Fundamentals of Vehicle Dynamics , Society of Automotive Engineers 2. Giles J. G., Steering , Suspension and tyres , ILIFFE Books Ltd.
2. Ellis J. R., Vehicle handling dynamics, Mechanical Engineering Publications Ltd. London

**Reference Books :**

1. Dixon J. C. ,Tyres, Suspension and handling ,Cambridge university press.
2. Wong J.Y., Theory of Ground vehicles, John Wiley & Sons.

|  |
| --- |
| **Title : Syllabus Format – PG Courses FF No. : 658** |
| **ME571TH : Mechanics of Composite Materials** |
|  |
| **Credits: 04 Teaching Scheme: 3hrs / Week****Lab: 2hrs/week** |
| **Course Objectives**1. To provide students with a perspective on utilization of composite materials in machines and structure
2. To teach students to analyze composite materials using anisotropic continuum theory.
3. To provide students with a design experience involving composite materials
 |
| **Course Outcomes**Students will be able to -1. Understand the merits of composite material as competing materials to traditional materials and suggest suitable composite as replacement for existing structural application.
2. Understand the specifics of mechanical behavior of layered composite compared to isotropic material and apply constitutive equations of composite materials considering mechanical behavior at micro, macro level.
3. Apply appropriate failure criterion and determine stresses and strains in composite.
4. Suggest suitable manufacturing & testing method for component made of composite material.
5. Comprehend current research findings as reported in journals in the field of Composite materials.
 |
| **Unit 1: Introduction to Composite Materials (06 Hrs)** Introduction to Composite Materials, Advantages & Applications, basic concepts, Constituent Materials, Manufacturing Methods, Methods of non-destructive evaluation of polymer composites. |
| **Unit 2 : Composite Lamina-Micromechanics (07 Hrs)** Elastic behavior of composite lamina-Micromechanics: Micromechanics methods, Geometric aspects and elastic symmetry, longitudinal and transverse properties, inplane shear modulus, longitudinal properties of discontinuous fibers |
| **Unit 3 :Composite Lamina-Macromechanics (07 Hrs)** Elastic behavior of composite lamina-Macromechanics: Stress-Strain relations, relation between mathematical and engineering constant, transformation of stress & strain, elastic parameters, Stress-Strain relations in terms of engineering constants. |
| **Unit 4 : Strength of Unidirectional Lamina (07 Hrs.)** Strength of unidirectional lamina-Micromechanics: Longitudinal tension & compression, transverse tension & compression, inplane Shear and out of plane loading. Strength of unidirectional lamina-Macromechanics: Failure theories – Maximum stress theory, Maximum strain theory, Energy based theory, evaluation and applicability of lamina failure theories. |
| **Unit 5 : Multidirectional Laminates (07 Hrs.)** Elastic behavior of multidirectional laminates: Strain displacement relations, Stress-Strain relations of layer within laminate, load – deformation relations, symmetric laminates, orthotropic laminates, quasi-isotropic laminates. |
| **Unit 6 :Experimental Characterization and Testing (06 Hrs)** Experimental methods for characterization and testing of composite materials : Characterization of constituent Materials, Physical Characterization of composite materials, Determining Tensile, compressive , shear properties of Unidirectional lamina, Determination of through thickness properties, Interlaminar Fracture Toughness , Biaxial testing, Characterization of composite with Stress concentration. |
| **Total Contact Hours: 40****Laboratory work:** 1. Analysis of simple mechanical component made of composite material by FEA
2. Study and analysis of effect of fiber orientation on different properties of composites.

Study and analysis of effect of fiber materials and its volume ratio on different properties of composites |
| **Text Books :** 1. Engineering Mechanics of Composite Materials - Issac M Daniel & Ori Ishai , Oxford University Press Inc., New York 10016 **2.** Mechanics of Composite Materials and Structures - M. Mukhopadhyay, Universities Press  |
| **Reference Books** 1. Mechanics of Composite Materials - Autar K Kaw, CRC Press ,Taylor & Francis Group 2. Composite Materials – Design and Applications by Daniel Gay, Suong V. Hoa, Stephen W. Tsai ,  CRC press, Taylor & Francis Group 3. An Introduction to Composite Materials - Hull, D. and Clyne, T.W., Cambridge University Press 4. Mechanics of Composite Materials - R. M. Jones, Taylor & Francis, Inc. **5.** Theory and Analysis of Elastic Plates and Shells - Reddy, J. N., CRC Press  |

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME572TH : OPTIMISATION TECHNIQUES**

**Credits: 04 Teaching Scheme: 3hrs / Week**

**Lab: 2hrs/week**

**Course Objectives:**

* + 1. To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems
		2. To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology
		3. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems.

**Course Outcomes:**

**The students are able to**

1. Gain the knowledge of various optimization techniques
2. Develop the ability to obtain the optimal solution for engineering problems
3. Understand the concepts of one-dimensional optimization, gradient based methods, linear programming, constrained optimization and evolutionary algorithms
4. Model engineering problems and pose it as an optimisation problem
5. Apply the optimisation methods to design a mechanical system
6. Select and implement proper optimization technique as per the required application

**Unit 1 : ( 7Hrs)**

 Review of Maths, calculus, linear algebra, function of several variables, extrema, constrained extrema, Single variable Optimization methods – polynomial (quadratic, cubic) methods, golden search method, iterative methods

**Unit 2 : (7 Hrs)**

Gradient based methods: conjugate gradient, steepest descent, examples. Constrained optimization: Lagrange multipliers, transformation, linearization methods

**Unit 3 : (7 Hrs)**

Linear programming: simplex, dual simplex, case studies.

**Unit 4: Operations Research (7 Hrs)**

Methods / Algorithms for Transportation problem, Queuing theory, Inventory management, Scheduling, Game theory, etc.

**Unit 5 : Modern / Advanced /Evolutionary methods of Optimization (7Hrs)**

**Unit 6 : (5Hrs)**

Optimization in Mechanical Design, Use of Software applications for Optimization (like Matlab, ANSYS, Catia, Spreadsheets, etc.), Topology Optimization, Case studies

**Total Contact Hours: ( 40 )**

**Laboratory work**

1. Optimization of a mechanical component/ system using Matlab
2. Optimization of a thermal system using Matlab
3. Optimization of turbo machines

**Reference Books :**

1. Optimization: Theory and Practice, Mohan Joshi and KannanMoudgalya, Narosa Publishing House, Bombay.
2. Optimization: concepts and application engineering, Ashok Belegundu and TirupathiChandrupatla, Pearson Education Asia, Delhi.
3. Engineering Optimization, Singiresu S. Rao, New Age International (P) Ltd., Bombay

**Title: Syllabus Format – PG Courses FF No. : 658**

**ME573TH : Process Equipment Design**

**Credits: 04 Teaching Scheme: 3hrs / Week**

**Lab: 2hrs/week**

**Course Objectives**:

* + 1. Understand the content of process flow diagrams (PFD)
		2. Understand the content of piping and instrument diagrams (P&ID)
		3. Introducing students to various design codes
		4. To enable students to apply the requirements of the relevant industry standards to the mechanical design of equipments used in the process industry and above ground atmospheric storage

**Course Outcomes:**

1. Students will have understanding of several design codes used in the design.
2. Students will be able to understand the calculation of line sizes and pressure drops, flow measurement sizing and develop a flow measurement process data sheet.
3. Students will have understanding of design and analysis of vessels and tanks
4. Students will have understanding of the principles of process equipment design, the mechanical aspects of the design and operation of process equipment, including safety considerations.
5. Students will be able to complete detailed designs of several process equipment’s.
6. Students will be able to understand the concept of planning, manufacturing, inspection and erection of process equipment’s

**Unit 1 :Process Design Parameters ( 7 Hrs )**

Basic concepts in process design, block diagrams for flow of processes, material flow balance. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515.

B)Process Control :

Fundamentals of process measurements and control modern control devices and other controls of major unit operation and processes. Applications of CAD to process Equipment Design.

**Unit 2 : Design of Cylindrical and Spherical Vessels** **( 7 Hrs )**

Thin and thick walled cylinder analysis, design of end closers, local stresses due to discontinuity or change of shape of vessel, vessel opening compensation, design of standard and non-standard flanges, design of vessels and pipes under external pressure, design of supports for process vessels.

**Unit 3 : Design of Tall Vessels and Large Storage Tanks** **( 7 Hrs )**

Determination of equivalent stress under combined loadings including seismic and wind loads application of it to vertical equipment like distillation column.

**Unit4 :Process Equipment Design ( 7 Hrs )**

Storage vessels, reaction vessels, agitation and mixers, heat exchangers, filters and driers, centrifuges. Code practices, selection and specification procedures used in design. Selection of pumps, compressors, electrical equipment’s and auxiliary services, safety, etc.

**Unit 5 :Process Piping Design ( 6Hrs )**

Flow diagrams and pipe work symbols, design of layout of water, steam and compressed air pipes work, pipe fitting, linings and flanged connections. Types of valves used on pipe line. Fabrication of pipe lines, expansion joints and pipe supports.

**Unit 6 : ( 6Hrs )**

Planning, manufacture, inspection and erection of process equipment like pressure vessels, chimneys, ducting, heat exchangers, pulverising equipment, etc. protective coatings, lining of vessels.

**Total Contact Hours: 40 Hrs.**

**Laboratory work:**

1. Autocad assignment on process flow diagram
2. Visit report for any process industry like sugar factory.
3. Pipe stress analysis
4. Design and analysis of storage tank
5. Design and analysis evaporator system

**Text Books:**

* 1. Process Equipment Design : By Dr. M.V. Joshi, Mc-Millan.
	2. Process Equipment Design : By Browell and Young, John Wiley.
	3. Plant Design and Economics : Max and TimasulausKalus – McGraw Hill.
	4. Industrial Instrumentation servicing Hand Book : Cannel Grady, McGraw Hill.

**Reference Books :**

* 1. Handbook of Instrumentation and Control : Kellen Heward, McGraw Hill.
	2. Chemical Engineering Handbook : Perry John, McGraw Hill.
	3. Chemical Equipment Design : B.C. Bhattacharya.
	4. Industrial Pipe Work : D.N.W. Kentish, McGraw Hill.
	5. Chemical Engineering : J.M. Coulson, Richardson, Sinnott Vol. VII, Maxwell, McMillan.
	6. Pressure Vessel Design Hand Book : H. Bedna.
	7. Dryden’s outlines of Chemical Technology for the 2 : By Roa M. Gopala, Sitting M., East West Press Pvt. Ltd., New Delhi.
	8. Applied Process Design for Chemical and Petrochemical, Vol. I, II and III : By E.E. Ludwig, Gulf Publication Co., Houston.
	9. Chemical Process Control : An Introduction to Theory and Practice : By Stephanopoulos G., Prentice Hall of India, New Delhi.
	10. Chemical Process Equipment Selection and Design : By Stanley M.Walas, Butterworth-Heinemann Series in Chemical Engineering.
	11. Process System Analysis and Control : By D.R. Coughanowr, McGraw Hill, New York.
	12. Engineering Optimsiation: Theory and Practice : By Rao S.S., New Age Publishing Co., New Delhi.
	13. Optmisation of Chemical Processes: By Edgar T.F., Himmelblau D.M., McGraw Hill Book Co., New York.
	14. Control Devices, Vol. I and II : Liptak
	15. Analysis, synthesis and design of Chemical Processes: Richard Turton, Richard C. Bailie, Wallace B. Whiting, Josheph A. Shaewitz, Prentice Hall Int. Series in Physical and Chemical Science.

**SEMESTER III**

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME661TH : Reliability Engineering**

**Credits: 03 Teaching Scheme: 3hrs / Week**

**Course Objectives:**

1. To summarize reliability engineering and its management throughout the product life cycle.
2. To perform reliability engineering analysis.
3. To compute reliability engineering parameters and estimates for applications in mechanical devices and manufacturing environments.

**Course Outcomes:**

Students will be able to-

1. Understand basic reliability measures such as MTTF, MTBF, MTTR, availability, failure rate, Bathtub curve, etc.
2. Compute and evaluate reliability for redundant, series, and parallel systems
3. Evaluate maintainability and availability of a system
4. Perform failure mode, effects and criticality analysis for a system

**Unit 1: Fundamental concepts (7 Hrs)**

Reliability definitions, failure, Failure density, Failure Rate, Hazard Rate, Mean Time To Failure, MTBF, maintainability, availability , pdf, cdf, safety and reliability, Quality, cost and system effectiveness, Life characteristic phases, modes of failure, Areas of reliability, Quality and reliability assurance rules, product liability, Importance of Reliability,

**Unit 2: Probability theory (5 Hrs)**

Set theory, laws of probability, total probability theorem, probability distributions binomial, normal, poisson , lognormal, weibull , exponential, standard deviation, variance, skewness coefficient , chebyshev inequality, central limit theorem.

**Unit 3: System reliability and modeling (7 Hrs)**

Series, parallel, mixed configuration, k- out of n structure, complex systems- enumeration method, conditional probability method, cut set and tie set method, Redundancy, element redundancy, unit redundancy, standby redundancy- types of stand by redundancy, parallel components single redundancy, multiple redundancy. Markov analysis.

**Unit 4: Maintainability and Availability (6 Hrs)**

Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system down time, Availability - Inherent, Achieved and Operational availability, reliability and maintainability trade-off.

**Unit 5: System reliability Analysis (7 Hrs)**

Reliability allocation or apportionment, Reliability apportionment techniques – equal apportionment, AGREE, ARINC, feasibility of objectives apportionment, dynamic programming apportionment, Reliability block diagrams and models, Reliability predictions from predicted unreliability, minimum effort method.

**Unit 6: Failure Mode, Effects and Criticality Analysis (8 Hrs)**

Failure mode effects analysis, severity/criticality analysis , FMECA examples, RPN, Ishikawa diagram for failure representation , fault tree construction, basic symbols development of functional reliability block diagram, Fau1t tree analysis, fault tree evaluation techniques, minimal cut set method, Delphi methods, Monte carlo evaluation.

**Total Contact Hours: 40**

**Reference Books**

1. A.K. Govil, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1983.
2. B.S. Dhillion, C. Singh, Engineering Reliability, John Wiley & Sons, 1980.
3. M.L. Shooman, Probabilistic, Reliability, McGraw-Hill Book Co., 1968.
4. P.D.T. Conor, Practical Reliability Engg., John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, Reliability in Engineering Design, John Wiley & Sons, 1977.
6. A.Birolini , Reliability Engineering, Theory and Practice, Third Edition, Springer, 1999

**Text Books:**

1. L.S. Srinath, Concepts of Reliability Engg., Affiliated East-Wast Press (P) Ltd., 1985.
2. E. Balagurusmy, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1984.

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME662TH: Chassis and Body Engineering**

**Credits: 03 Teaching Scheme: 3hrs / Week**

**Course Objectives:**

1. To help students to understand constructional details of car body and chassis design.
2. To help students to understand safety concepts in car body and chassis design.

**Course Outcomes:**

* + 1. Students will understand classification of vehicle body according to body shape.
		2. Students will understand the underlying concepts and methods behind automobile chassis and body design.
		3. Students will be able to evaluate different loads coming on the chassis and body.
		4. Students will understand safety measures in design of the chassis and body.
		5. Students will understand testing procedure for chassis and body.

**Unit 1: Car Body Details-1 (6Hrs)**

Car Body Details : Types of car bodies, visibility, regulations, driver’s visibility, methods of improving visibility, safety design.

**Unit 2: Car Body Details-2 (4 Hrs)**

Car Body Details : constructional details of roof, under floor, bonnet, boot, wings etc, Classification of coach work.

**Unit 3: Design of Vehicle Bodies (4 Hrs)**

Design of Vehicle Bodies: Vehicle body materials, Layout of the design, preliminary design, safety, Idealized structure- structural surface, shear panel method, symmetric and asymmetrical vertical loads in car, longitudinal loads, different loading situations- load distribution on vehicle structure.

**Unit 4: Analysis of Vehicle Bodies (4Hrs)**

Calculation of loading cases, stress analysis of bus body structure under bending and torsion, stress analysis in integral bus body, Design of chassis frame, Rules and regulations for body.

**Unit 5: Safety Measures (5 Hrs)**

Recent safety measures, Testing of body.

**Unit 6: Design of Chassis Frame (5Hrs)**

Design of Chassis Frame: layout, components, performance requirement, Strength of material techniques, Materials,

**Total Contact Hours: 28Hrs**

**Text books:**

* + - 1. Commercial vehicle Structures – By Beerman
			2. Vehicle Body Engineering – Pawloski J., Business Books Ltd.

**Reference Books:**

* + - 1. The Automotive Chassis: Engineering Principles – Reimpell J.
1. Vehicle Body Layout and Analysis – John Fenton, Mechanical Engg. Publications Ltd.London
2. Body Construction and Design – Giles J. G., Illife Books, Butterworth and Co.

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME614TH : Design of Experiments**

**Credits: 03 Teaching Scheme: 3hrs / Week**

**Course Objectives:**

1. To design and conduct experiments, as well as to analyze and interpret data.
2. To cover the statistical design of experiments for systematically examining functioning of the system

**Course Outcomes:**

Students will be able to-

1. An ability to design a system, component, or process to meet desired needs within realistic constraints
2. Plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions.
3. To utilize standard statistical software packages for computational purposes.
4. Design/apply fractional factorial experiments for simple experimental case studies and analyze data collected for such experiments.

**Unit I: Overview and Basic Principles (5 Hrs)**

The Experimenter's Problem and Statistical Methods, Experimental units, treatments, factors, and other terms. Randomizing to eliminate bias and confounding; randomizing run-orders and other things; randomization as a basis for statistical inference; paired and 2-sample t-tests.

**Unit II: Completely Randomized Design (5 Hrs)**

Random variables; probability distributions; means, variances, and covariances; models; summary statistics; transforming to normality. The fixed effects model; the ANOVA decomposition and why ANOVA works; post hoc mean comparisons; contrasts; residual analysis for validating assumptions.

**Unit III: Factorial Designs (5 Hrs)**

The analysis of experiments with two or more fixed treatment factors. Fixed effects models; main effects versus interactions; characterizing interactions; interpretation of F-ratios; contrasts and post hoc mean comparisons; unreplicated designs.

**Unit IV: Random, Mixed, and Nested Effects (5 Hrs)**

Random effects models; ANOVA for random effects; variance components; expected mean square algorithm; exact and approximate F-tests for random factors; Mixed effects models; the expected mean square algorithm; exact and approximate F-tests;

**Unit V: Designs with Restrictions on Randomization (4 Hrs)**

Blocking; the randomized complete block design; Latin squares and Graeco-Latin squares; cross-over designs. Whole plot, sub-plot, and sub-sub-plot structure and restricted randomization; split-plot, split-split plot, and split-block designs

**Unit VI: Response Surface Methodology and Robust Product Design (4 Hrs)**

Introduction to Response Surface Methodology, The Method of Steepest Ascent, First-Order Models, First-Order Designs, Analyzing First-Order Data,

Environmental Robustness, Robust parameter design, Robustness to Component Variation, Mathematical Formulation for Environmental Robustness.

**Total Contact Hours: 28 Hrs.**

**Text books:**

1. Box, GEP, Hunter, WG, and Hunter, JS, 1978, Statistics for Experimenters, Wiley.
2. Box, GEP and Draper, NR 1987, Empirical Model-Building and Response Surfaces, Wiley.

**Reference Books:**

1. Cochran, W.G and Cox, G.M, 1957, Experimental Designs, Wiley.
2. Fisher, R A, 1966, The Design of Experiments, 8th ed., Hafner.

**Title : Syllabus Format – PG Courses FF No. : 658**

**HS66101: Organizational Management**

**Credits: 03 Teaching Scheme: 3hrs / Week**

**Course Outcomes:**

An engineering graduate student about to enter industry will be able to learn

1. Use of EFQM Model of Business Excellence
2. Introduction to Quality Management System as per ISO 9001, Environmental Management System as per ISO 14001, Operational Health and Safety Assessment Specifications OHSAS 18000 and Information Security Management System as per ISO 17799
3. Problem Solving Techniques
4. Introduction to Six Sigma concept
5. Introduction to Toyota Production System
6. Introduction to statistical terminologies, their use in calculations for practical applications.
7. Statistical Quality Control tools.
8. Introduction to TQM, Kaizen, and concepts of Just in time, Kanban, 5”S”, Quality Circles

9) Concepts of Cost of Quality, Total Productive Maintenance

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Course Outcomes/Units |  I |  II |  III |  IV |  V |
| 1 |  **\*** |  |  |   |  \* |
| 2 |   |  \* |  \* |  \* |   |
| 3 |  |  |  |  \* |  |
| 4 |  |  |  \* |  \* |   |
| 5 |  |   |  |  \* |  |
| 6 |  |  |  \* |  \* |  |
| 7 |  |  |  \* |  \* |  |
| 8 |  \* |  \* |  \* |  \* |   |
| 9 |  \* |  \* |  \* |  \* |  **\***  |
| Outcome attainmentthrough | Internal Class testCase Study | Mid semTestCase Study | Mid semTestCase Study | End sem testCase Study | Internal Class test,Case Study |

**Topics to be covered**

1. EFQM model of Business Excellence
2. Statistics and SQC
3. TQM, Kaizen, 5 “S”, Cost of Quality, TPM
4. Problem Solving Techniques
5. JIT, KANBAN
6. Six Sigma, Toyota Production System
7. QMS ISO 9000, EMS ISO 14000
8. OHSAS 18000, ISMS ISO 17799
9. Contributions by Deming, Taguchi, Henry Ford

10) Malcolm Baldrige Award

**Title: Syllabus Format – PG Courses FF No. : 658**

**HS66102 :Business Economics**

**Credits: 03 Teaching Scheme: 3hrs / Week**

**Course Objectives:**

1. To understand the concept and distinct types of engineering and science research
2. To understand the research process in detail in terms of ideation, concept, design and implementation of research.
3. To develop expertise in studying, writing and presenting technical documentation such as papers, thesis, etc.
4. To understand and get exposed to different tools and techniques essential for research

**Course Outcomes:**

1. Get familiar with basic concepts of economics, acquire basic knowledge of Micro, Macro Economics, inflation, taxation and money.
2. Gain information and knowledge on Laws of demand and supply, in depth study of elasticity f dem and supply with numerical problems.
3. Understand Production functions, Laws of variable proportions, Laws of diminishing returns and Learning curve
4. Analysis of competition, and other business environments

**Unit 1: (6 Hrs)**

Definition, Nature and Scope of Managerial Economics. Introduction to Microeconomic and Macroeconomics. Managerial Economics and decision-making. Interest, taxes, inflation, currency fluctuations, depreciation and their effects on decision making.

**Unit 2: (6 Hrs)**

Law of Demand & Supply: Meaning and Determinants of Demand. Demand Function. Law of Demand, Market Demand, Elasticity of demand. Types of elasticity. Measurement of elasticity. Significance and uses of the elasticity. Meaning and Determinants of Supply, Law of supply. Equilibrium of demand and supply i.e. price determination.

**Unit 3: (6 Hrs)**

Production Function. Law of Variable Proportions. Costs of production. Accounting Costs and Economic costs, Short run and Long Run costs, Relevant (Future) and Irrelevant Costs (Past or Sunk Costs), Direct (Prime) Cost and Indirect Cost (Overheads), Economies of scale: Relevance to Mfg and Services, Learning Curve

**Unit 4: (6 Hrs)**

Types of Competition: Monopoly, Monopolistic competition, Duopoly, Oligopoly. Perfect Competition Need for Government Intervention in Markets. Price Controls. Support Price. Preventions and Control of Monopolies. System of Dual Price.

**Total Contact Hours: 24**

**Text Books:**

1. Engineering Economic Analysis, Theusen H.G., Prentice Hall of India
2. Engineering Economic Principles, Henry M. Steiner, McGraw Hill
3. Engineering Economics, S.M. Mahajan, Everest Publishing House, Pune
4. Managerial Economics – Analysis**,** Problems and Cases, P.L. Mehta, Sultan Chand Sons, New Delhi.
5. Managerial Economics – Varshney and Maheshwari, Sultan Chand and Sons, New Delhi.
6. Managerial Economics – G.S. Gupta, T M H, New Delhi.
7. Managerial Economics – Mote, Paul and Gupta, T M H, New Delhi.

 **Reference Books:**

1. Managerial Economics –Joel Dean, Prentice Hall, USA.
2. Managerial Economics – Pearson and Lewis, Prentice Hall, New Delhi
3. Managerial Economics – D. Salvatore, McGraw Hill, New Delhi.
4. Economics ,PA Samuelson, WD Nordhaus, Tata McGraw Hill

**Title: Syllabus Format – PG Courses FF No. : 658**

**ME672PS / ME673PS : Technical Seminar**

**Credits: 02 Teaching Scheme: 2hrs / Week**

**Course Objectives:**

1. To empower the student to learn beyond what is taught in class by reviewing literature available at large
2. A student is expected to review research papers periodicals , magazines and review publications on the internet and in other electronic resources.
3. Student is expected to present views coherently to produce a presentation concisely with the surveyed information under the direction of the research guide.

**Course Outcomes:**

Under the influence of the project guide -To engage the student directly or indirectly in research at different levels, from advancing their course materials, professional development, to funded research projects to advance the state of practice.

SCOPE

The scope of the technical seminar will include but not restricted to the discipline of work for the final year thesis.

The scope will include:

 Survey of patents,

Research journals books and databases

Field survey and site visit reports

Communication from experts .

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME675PRJ / ME676PRJ: Dissertation Stage I**

**Credits: 12**

**Course Objectives:**

 1. To help the students to apply theoretical knowledge to any practical problem.

 2. To develop technical report writing and presentation of the students.

**Course Outcomes:**

1. Student should identify problem and decide scope of his dissertation work.

 2. Student should complete literature review for dissertation work.

**Guidelines**

Candidates are required to do project during the entire second year of the course. The work is divided into two parts, Project Stage-I during the third semester and project stage-II during the fourth semester.

Candidates are required to solve/analyze a mechanical engineering problem or develop any innovative concept/design in mechanical engineering during this period. The problem can be solved/ analyzed with the help of experiments which can be performed on a specially developed set ups or modified existing set up. The work can be based on analysis of components/ subsystems/systems using softwares. The work can also be based on exhaustive numerical analysis. The work can be combination of experimentation and software/numerical analysis. The results obtained need to be validated.

It is expected that, following work be completed during project stage-I.

* + - 1. Defining objectives and scope of the project work.
1. Literature review to understand the issues related to the work.
2. Development of the experimental set up, procedure for the experimentation and calibration
3. of the instrument.
4. Study of different softwares to be used for the analysis.
5. Mathematical techniques required for the project work.
6. Sample reading or analysis of sample components needs to be done so as to become familiar with the set up/software/mathematical tools.

A Mid-Semester review will be conducted to finalise the scope and objective of the project work. Project stage I examination will be conducted based on the work completed during this stage.

**Title: Syllabus Format – PG Courses FF No. : 658**

**ME671INT : Industrial in plant training**

**Credits: 06**

Semester long (minimum 14 weeks) industrial training in Mechanical Industries

**Course Outcomes:**

1. Students will be able to correlate the theoretical and practical concepts
2. Students will be able to understand various processes of product developments and services

3. Students will be able to understand industrial works and management

4 .Students will be able to demonstrate verbal, written and graphical communication skills.

5. Students will be able to undertake technical discussions.

**SEMESTER IV**

**Title : Syllabus Format – PG Courses FF No. : 658**

**ME677PRJ : Dissertation Stage II**

**Credits: 20**

**Course Objectives:**

1. To develop technical report writing and presentation of the students.
2. The student should be able to construct mathematical and experimental analysis of a practical problem.
3. The students should be able to analyze the simulation and experimental data and draw technical conclusions based on the same.

**Course Outcomes:**

1. Dissertation report with technical conclusions based on simulation and or experimental results.

**Guidelines**

Project stage II is essentially continuation of the project stage I. The objectives and scope of the project work are defined during the project stage I.

The problem is completely solved during the project stage II. The results obtained are to be validated during this stage of the project. In case of any innovative concept the work would include completely developing the component/product/ process etc. and proving the results. The project work can be presented during the examination conducted as per the institute norms. It is expected that at least one publication / presentation on any relevant platform to be made before final examination.