Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

Revised Structure and Syllabus

CHOICE BASED CREDIT SYSTEM

Syllabus: Mechanical-Design Engineering

Name of the Course: M.Tech.- Semester I, II, III & IV

(Syllabus to be implemented from w.e.f. June 2018-19 & 2019-20)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

FACULTY OF SCIENCE & TECHNOLOGY
Curriculum for M. Tech.(Mechanical-Design Engineering)
Four Semester Course
Choice Based Credit System (CBCS) - (WEF 2018-19)

Semester I: Theory /Tutorial/ Lab Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
1	Advanced Stress Analysis	3	-	-	3	70	30	-	100
2	Advanced Vibrations and Acoustics	3	-	-	3	70	30	-	100
3	Industrial Instrumentation	3	-	-	3	70	30	-	100
4	**Elective- I** 1. Computational Techniques in Design Engineering 2.Reliability Engineering 3.Mechanical System Design 4. Computer Aided Design	3	-	-	3	70	30	-	100
5	Research Methodology and IPR©	3	-	-	3	70	30	-	100
6	Advanced Vibrations and Acoustics Lab	-	-	2	1	-	-	50	50
7	Industrial Instrumentation Lab	-	-	2	1	-	-	50	50
8	Seminar –I		2		2			50	50
	Total	**15**	**2**	**4**	**19**	**350**	**150**	**150**	**650**

L Lecture
T Tutorial
P Lab Session

FA Formative Assessment
SA Summative Assessment
ESE End Semester Examination
ISE In Semester Evaluation
ICA Internal Continuous Evaluation

© - This Course is common for M. Tech. (Civil- Structural Engineering) and M. Tech. (Mechanical-Design Engineering)

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FACULTY OF SCIENCE & TECHNOLOGY

Curriculum for M. Tech. (Mechanical-Design Engineering)

Four Semester Course

Choice Based Credit System (CBCS)- (WEF 2018-19)

Semester II: Theory /Tutorial/ Lab Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
1	Finite Element Method	3	-	-	3	70	30		100
2	Advanced Design Engineering	3	-	-	3	70	30		100
3	Industrial Product Design	3	-	-	3	70	30		100
4	**Elective- II** 1. Theory and Analysis of Composite Materials 2. Engineering Design Optimization 3. Industrial Tribology 4. Advanced Engineering Materials	3	-	-	3	70	30		100
5	**Elective- III** 1. Engineering Fracture Mechanics 2. Project Management 3. Design for Manufacture and Assembly 4. Analysis and Synthesis of Mechanisms and Machine	3	-	-	3	70	30		100
6	Finite Element Method Lab	-	-	2	1	-		50	50
7	Product Design Lab	-	-	2	1	-		50	50
8	Seminar-II	-	2	-	2	-	-	50	50
	Total	**15**	**2**	**4**	**19**	**350**	**150**	**150**	**650**

L Lecture
T Tutorial
P Lab Session

FA Formative Assessment
SA Summative Assessment
ESE End Semester Examination
ISE In Semester Evaluation
ICA Internal Continuous Evaluation

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Semester III: Theory /Tutorial/ Lab Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
Dissertation	Lab Practices	-	-	2	2	-	-	50	50
	Open Elective	3	-	-	3	70	30	-	100
	Dissertation Phase I : Synopsis Submission Seminar*	-	-	2	2	-	50	-	50
	Dissertation Phase II : Progress Seminar	-	-		8	100	200	-	300
Total		**3**	**-**	**4**	**15**	**170**	**280**	**50**	**500**
Note:- * indicates student engagement against which faculty contact hour is 2 hours per candidate									

L Lecture
T Tutorial
P Lab Session

FA Formative Assessment
SA Summative Assessment
ESE End Semester Examination
ISE In Semester Evaluation
ICA Internal Continuous Evaluation

List of open Elective

1. Business Analytics
2. Operation Research
3. Cost Management of Engineering Projects
4. Non conventional Energy

- For all activities related to dissertation Phase I (synopsis submission seminar and progress seminar) student must interact regularly every week with the advisor.
- Synopsis submission seminar shall cover detailed synopsis of the proposed work. Student shall submit Synopsis of the Dissertation Work only after delivering this seminar.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation.
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the Department before delivering the seminar. A PDF copy of the report must be submitted to the advisor along with other details if any.
- Lab Practice shall include any of the below activities as recommended by Advisor and student shall submit a report after completion of the activity to Advisor along with other details if any. Software / hardware assignments, learning new software, literature survey, filed work, industrial training etc. related to dissertation work.
- Details of modes of assessment of seminar and dissertation shall be as specified in 7(III) of PG Engineering Ordinance of Solapur University, Solapur.

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Four Semester Course
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Semester IV: Laboratory / Tutorial Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
Dissertation	**Dissertation Phase –III** Progress Report presentation and submission		-	4	3	-	-	100	100
	Dissertation Phase –IV Final presentation and submission of report	-	-	2	6	-	-	100	100
	Dissertation Viva voice	-	-	-	6	200	-	-	200
Total		**-**	**-**	**6**	**15**	**200**		**200**	**400**
Note:- * indicates student engagement against which faculty contact hour is 3 hours per candidate									

L	Lecture	**FA**	Formative Assessment
T	Tutorial	**SA**	Summative Assessment
P	Lab Session	**ESE**	End Semester Examination
		ISE	In Semester Evaluation
		ICA	Internal Continuous Evaluation

- For all activities related to dissertation Phase III, student must interact regularly every week with the advisor.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation.
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the Department before delivering the seminar. A PDF copy of the report must be submitted to the faculty advisor along with other details if any.
- Details of modes of assessment of seminar and dissertation shall be as specified in 7(III) of PG Engineering Ordinance of Solapur University, Solapur.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Advanced Stress Analysis

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks
ISE: 30 marks

Course Contents

SECTION-I

UNIT 1: Theory of Elasticity **(6)**

Analysis of stress, analysis of strain, differential equations of equilibrium, boundary conditions, compatibility equations, Airy stress function, Bi harmonic equations

UNIT 2: Two dimensional problems in rectangular coordinates. **(6)**

Solution by polynomials. Saint Venant's principle, Determination of displacements, bending of a Cantilever loaded at the end, bending of beam by uniform load and other cases

UNIT 3: Pressurized Cylinders and rotating disks **(8)**

Governing Equations, stresses in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with uniform strength.

SECTION-II

UNIT 4: Shear centre **(5)**

Concept of shear centre in symmetrical and unsymmetrical bending. Shear centre for thin wall beam section, open section with one axis of symmetry, general open and closed section.

UNIT 5: Theory of Torsion **(5)**

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of noncircular shaft. Torsion of elliptical shaft.

UNIT 6: Contact stresses **(5)**

Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stresses for two bodies in line contact with load normal to the contact area.

UNIT 7: Introduction to energy methods **(5)**

Energy methods for analysis of stress, strain and deflection, theorems of virtual work, castigliano's theorem, Rayleigh Ritz method.

Reference Books:

1. Theory of Elasticity - Timoshenko and Goodier, McGraw Hill
2. Elasticity; Theory, Applications and Numeric's - Martin H.Sadd, Academic Press
3. Solid Mechanics: S.M.A Kaizimi - McGraw Hill
4. Advanced strength of Materials - J.P.DenHarteg MGH books co Ltd.
5. Elasticity in Engineering Mechanics, Boresi A.P and K.P. Chong, Second Edition John Wiley and Sons
6. Advanced Mechanics of Solids:Srinath L.S. McGraw Hill

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Advanced Vibrations and Acoustics

Teaching Scheme	**Examination Scheme**
Lectures-3Hrs/week	**ESE**- 70 Marks
Practical- 2 Hrs/Week	**ISE-**30 Marks
	ICA-50 Marks

Course Contents

SECTION-I

Fundamentals of Vibration **(4)**

1 Review of Single and Two degree freedom systems subjected to Forced and Motion Excitation. Response to arbitrary periodic and a periodic excitations Impulse response Transient vibration- Laplace transformation formulation. Fourier transforms- definition, Relation to transfer functions, first order systems, applications. Basic Concepts like Passive, Semi active and Active Parameters

2 **Two Degree Freedom System** **(6)**

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 Freedom System** **(6)**

Equation of motion for multi degree 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 damped and Undamped system, Methods to determine natural frequencies of multi DOF system, Rayleigh's Method, Holzer method and matrix iteration method

4 **Vibration of Continuous Systems** **(4)**

Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous system

SECTION-II

5 **Experimental Methods in Vibration Analysis** **(4)**

Vibration instruments - Vibration exciters, Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Collection of FRF, experimental modal analysis methods, Examples of vibration tests - Industrial case studies

6 **Non-Linear Vibrations** **(6)**

Introduction, Sources of nonlinearity, 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 Nonlinear spring (Duffing's equation)

7 Random Vibrations **(6)**

Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response

8 Fundamentals of acoustics **(4)**

Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source

Term Work: Term Work:

A) Assignments-

1. Application of sensors and related instrumentation for time and frequency domain
2. Assignment on measurement of dynamic test data of machine elements
3. Assignment on solving vibration problems using MATLAB software
4. Assignments on dynamic analysis using FEA software like ANSYS, NASTRAN etc.
5. Assignment on numerical methods for determination of natural frequencies

B) Experiments-

1. Modal testing and analysis for natural frequencies and mode shape for structures
2. Vibration measurement and spectral analysis
3. Noise measurement and spectral analysis

References Books:

1. Rao,J.S. & Gupta K., "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., 1984.
2. Thomson, W.T., "Theory of Vibration with Applications" CBS Publishers and Distributors, New Delhi, 1990
3. Den Hartog, J.P., "Mechanical Vibrations", Dover Publications, 1990.
4. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995.
5. D.J. Ewins, Modal Testing: Theory and Practice, Research Press Ltd, Letch worth (Herefordshire, England) (1984).
6. M.I. Friswell, J.E. Mottershead, Finite Element Model Updating in Structural Dynamics (Solid Mechanics & Its Applications.) Kluwer Academic Publishers (1995)
7. Mechanical Vibrations - S. Graham Kelly, Schaum's Outlines, Tata McGraw Hill, 2007
8. Elements of Vibration Analysis, LenordMeirovitch, Mc, Graw Hill Ltd, 2004
9. Vibration: Fundamental and Practice, Clarence W. de Silva, CRC Press LLC, 2000.
10. Fundamentals of Mechanical Vibration. - S. Graham Kelly. 2 nd edition McGraw Hill.
11. Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley Eastern Ltd., 1987.
12. Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II. , Chemical Publishing Co., New York, 1977

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Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Industrial Instrumentation

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

Examination Scheme:
ESE: 70 marks
ISE: 30 marks
ICA-50 Marks

Course Outcomes:

At the end of the course:

1. The students will understand the different characteristics of the instruments.
2. Students will understand construction and working of the instruments.
3. Students will come to know the various applications of the instruments in industry.

Course Contents

SECTION-I

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 and power measurement **(4)**

5. Pressure and vacuum measurement, flow measurement **(4)**

SECTION-II

6. 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 Behavior Monitoring, Corrosion Monitoring **(4)**

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

The following experiments are to be performed in the laboratory

A) Assignments-

1. Assignment on static and dynamic characteristics of instrument

2. Signal & system analysis.

3. Assignment on Microprocessor & computer application in measurements.

B) Experiments -

1. Measurements of mechanical parameters:

a) Displacement b) Force c) Torque d) Speed

2. Measurement of hydraulic parameters:

a) Pressure b) Flow

3. Measurement of thermal parameters:

Temperature: Industrial thermo couples, Resistance thermometer, Pyrometer.

4. Measurement of vibration parameter:

a) Displacement, Velocity and Acceleration- Accelerometer b) Frequency –Vibration Analyzer

5. Measurement of Sound parameters (Microphone):

a) Sound intensity level b)Sound Power level c) Sound Pressure level

6. Condition monitoring & signature analysis applications.

Vibration signature analysis of different existing machines such as Lathe, Grinder, Milling etc.

Reference Books:

1. B. C. Nakra& K. K. Choudhary, “Instrumentation, Measurement & Analysis” Tata McGraw Hill Publications Pvt. Ltd., New Delhi.
2. Rangan & Sharma, “Instrument Devices & Systems” Tata McGraw Hill Publications Pvt. Ltd., New Delhi.
3. Earnest O Doeblin, “Measurement Systems: Applications & Design”, McGraw Hill International.
4. D.S. Kumar, Mechanical Measurement and Control

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Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Program Elective –I: (1) Computational Techniques in Design Engineering

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks
ISE: 30 marks

Course Contents

SECTION-I

1. Interpolation: Errors in numerical calculations, Interpolation by central differences, sterling Bessel and Everett Formulae, Interpolation Formula for unequal Intervals, Lagrange's interpolation formula, Newton's divided difference formula. **(07)**

2. Curve Fitting and mathematical modeling: **(07)**
Least square method for linear and non-linear functions, weighted least square methods, Mathematical Modeling of Physical Problems, modeling Concept, Modeling of Linear Differential Equations of Second order.

3. Solution of Linear System of Equations and Eigen value problems: Gauss Elimination with Pivoting, factorization method, Iterative methods, Gauss Jacobi method, Gauss Siedel method, power method to solve Eigen value problems, Eigen vectors-Jacobi method**.** **(06)**

SECTION-II

4. Numerical Integration and differentiation: Numerical Integration by Newton-Cotes formula, Romberg's method and Gauss Quadrature, numerical differentiation by central difference formula **(06)**

5. Numerical solution of Ordinary Differential Equation: Picard's Method, Euler's and Modified Euler's Method, Runge-Kutta Method (up to fourth order), Predictor-Corrector Methods, Milne, Adams Bashforth Moulten Methods, finite difference method to solve boundary value problems. **(07)**

6. Numerical solution of Partial differential equations: solution of Laplace equations, parabolic equations and hyperbolic equations. **(07)**

Books Recommended

1. Dr. B.S. Grewal, Numerical methods for science and Engg., Khanna publications.
2. M.K.Jain, Numerical methods for scientific and Engg. Computation, New age international publication.
3. Dr. P.K. Kandasami, Dr. K. Thilagavathy, Dr. K. Gunavathi, Numerical methods, S. Chand publication.
4. S. S. Shastry, Introductory methods of numerical analysis, Third edition, prentice hall of India publications pvt. Ltd.

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Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Programme Elective-I: (2) Reliability Engineering

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks
ISE: 30 marks

Course Contents

SECTION-I

1. Introduction: **(4)**

Brief history, concepts, terms and definitions, applications, the life cycle of a system, concept of failure, typical engineering failures and their causes, theory of probability and reliability, rules of probability, random variables, discrete and continuous probability distributions.

2. Failure Data Analysis: **(4)**

Data collection and empirical methods, estimation of performance measures for ungrouped Complete data, grouped complete data, analysis of censored data, fitting probability Distributions graphically (Exponential and Weibull) and estimation of distribution parameters.

3. **Reliability Measures:** **(6)**

Reliability function–R(t), cumulative distribution function (CDF)–F(t), probability density Function (PDF) – f(t), hazard rate function-λ(t), Mean time to failure (MTTF) and Mean time Between failures (MTBF), median time to failure (tmed), mode (tmode), variance (σ2) and Standard deviation (σ), typical forms of hazard rate function, bathtub curve and conditional Reliability.

4. Basic Reliability Models: **(6)**

Constant failure rate (CFR) model, failure modes, renewal and Poisson process, two Parameter exponential distribution, redundancy with CFR model, time-dependent failure Models, Weibull, Rayleigh, Normal and Lognormal distributions, burn-in screening for Weibull, redundancy, three parameter Weibull, calculation of R(t), F(t), f(t), λ(t), MTTF, tmed, tmode, σ2 and σ for above distributions.

SECTION-II

5. Reliability Evaluation of Systems: **(6)**

Reliability block diagram, series configuration, parallel Configuration, mixed configurations Redundant systems, high level versus low level redundancy, kout-of-n redundancy, and complex Configurations, network reduction and decomposition methods, cut and tie set approach for Reliability evaluation.

6. Maintainability and Availability: **(4)**

Concept of maintainability, measures of maintainability, meantime to repair (MTTR), analysis of downtime, repair time distributions, stochastic point processes, maintenance concept and procedures, availability concepts and definitions, important availability measures.

7. Design for Reliability and Maintainability: (6)

Reliability design process and design methods, reliability allocation, failure modes, effects and criticality analysis (FMECA), fault tree and success tree methods, symbols used, maintainability design process, quantifiable measures of maintainability, repair versus replacement.

8. **Reliability Testing**: **(4)**

Product testing, reliability life testing, burn-in testing, and acceptance testing, accelerated life testing and reliability growth testing.

Term Work:

Minimum eight assignments based on above topics with an emphasis on examples of reliability of components and systems.

Reference Books:

1. Charles E. Ebling, 2004, An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill Education Private Limited, New Delhi.
2. L. S. Srinath, 1991, "Reliability Engineering", East West Press, New Delhi.
3. Alessandro Birolini, 2010, "Reliability Engineering: Theory and Practice", Springer.
4. Guangbin Yang, 2007, "Life cycle reliability engineering", John Wiley and Sons.
5. Roy Billiton and Ronald Norman Allan, 1992, "Reliability evaluation of engineering systems: Concepts and techniques", Springer.
6. Patrick D.T. O'Conner, David Newton, Richard Bromley, 2002, "Practical Reliability Engineering", John Wiley and Sons.
7. W. R. Blischke, D.N.P. Murthy, 2003, "Case studies in Reliability and Maintenance", John Wiley and Sons.
8. Andrew Kennedy, Skilling Jardine, Albert H. C. Tsang, 2006, "Maintenance, Replacement and Reliability: Theory and Applications", CRC/Taylor and Francis.
9. Joel A. Nachlas, 2005, "Reliability Engineering: Probabilistic Models and Maintenance Methods "Taylor and Francis.
10 B.S. Dhillon, Chanan Singh, 1981, Engineering Reliability – New Techniques and Applications", John Wiley and Sons.
11. B. S. Dhillon, 1999, "Engineering Maintainability", Prentice Hall of India.

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Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Program Elective –I: (3) Mechanical System Design

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks
ISE: 30 marks

Course Outcomes:

At the end of the course:

1. The students will understand system concept in design.
2. The students will understand different system theories and how to model it.
3. The students will understand different optimization methods.
4. The students will understand system evaluation and system simulation techniques.

Course Contents

SECTION-I

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 **(4)**

Need of modeling, Model types and purpose, linear systems, mathematical modeling, Concept

5. Graph Modeling and Analysis

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

SECTION-II

6. Optimization Concepts

Optimization processes, Selection of goals and objectives-criteria, methods of optimization, Analytical, combinational, subjective. **(4)**

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 **(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. **(4)**

Reference Books:

1. Mechanical System Design- Siddiqui, Manoj Kumar Singh; New Age International
2. An Introduction to Engineering Design Method- V Gupta and PN Murthy, TMH, New Delhi
3. System Analysis and Project Management- Devid I Cleland, William R King, McGraw Hill.
4. Machine Design -Dieter

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Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Programme Elective-I: (4) Computer Aided Design

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks
ISE: 30 marks

Course Outcomes:

At the end of the course:

1. Have a conceptual understanding of the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems.
2. Understand 2D, 3D transformations and projection transformations
3. Get knowledge of various approaches of geometric modeling
4. Understand mathematical representation of 2D and 3D entities
5. Understand basic fundamentals of FEM

Course Contents

SECTION-I

Unit 1: CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules**. (4)**

Unit 2: Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping. **(8)**

Unit 3: Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation. **(8)**

SECTION-II

Unit 4: Computer Communications, Principle of networking, classification networks, network wring, methods, transmission media and interfaces, network operating systems **(4)**

Unit 5 : Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerance, etc. **(8)**

Unit 6: Finite Element Modeling and Analysis, Finite Element Analysis, finite element modeling, mesh generation mesh requirements, semiautomatic methods, fully automatic methods, design and engineering applications, System Simulation, Need of simulation, areas of applications, when simulation is appropriate tool / not appropriate, concept of a system, components of a system, discrete and continuous systems, model of a system, type of models, types of simulation approaches. **(8)**

References:

1. IbrahbimZeid, "CAD / CAM Theory and Practice".
2. Jim Browne, "Computer Aided Engineering and Design".
3. P. Radhakrishnan / V. Raju / S. Subramanyam, "CAD / CAM / CIM".
4. P.N. Rao, "CAD / CAM principles and applications", Tata Mcraw-Hill, 02.
5. Rogers / Adams, "Mathematical Elements for Computer Graphics".
6. Rooney and Steadman, "Principles of Computer Aided Design", Aug. 1993.
7. Jerry Banks / John Carson / Barry Nelson / David Nicol, "Discrete-Event System Simulation

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Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Research Methodology & IPR

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks
ISE: 30 marks

Course Contents
SECTION-I

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. **(7)**

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. **(7)**

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. **(6)**

SECTION-II

4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting & Development: technological research, innovation, patenting, development. International Scenario International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT**(7)**

5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and data bases. Geographical Indications. **(7)**

6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR **(6)**

References:

1. Krishnaswamy, K.N., Sivakumar, AppaIyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, (New York, John Wiley & Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, (New Delhi, New Age International Ltd. Publishers).
4. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill 2001.
5. John W Cresswell, (2009)-Research Design: Qualitative, Quantitative and Mixed Methods Approaches, (Sage Publications Pvt Ltd. 3rd Edition.)
6. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
7. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-I

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Seminar- I

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
ICA: 50 Marks

Objective of Seminar I:

1. should able to do literature survey on any topic relevant to Design Engineering.
2. Understanding Interpretation and report writing.
3. Learn Technical Presentation skill

Topic Selection: Topic should be based on the literature survey on any topic relevant to Design Engineering. It is desirable that the selected topic 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

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.

Guidelines lines for Seminar I report writing.

Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Different steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing –References – Tables – Figures – Conclusion – Appendices.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Finite element method

Teaching Scheme	**Examination Scheme**
Lectures 3Hrs/week	**ESE**- 70 Marks
Practical 2 Hrs/Week	**ISE-**30 Marks
	ICA-50 Marks

Course Contents

SECTION-I

1 Introduction (4)

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

2 Mathematics for Finite Element Methods (6)

Matrix Algebra, Vector, Tensors, Linear Algebra, PDE,ODE,Variation Calculus, Weighted Residual method

3 Finite Element Analysis Concepts (10)

a. Energy techniques in Mechanics, Concept of functional, Rayleigh dimensional bar element, one dimensional thermal element.

b. Governing differential equations, Weighted Residual methods strong 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.

SECTION-II

4 FEM Modeling (10)

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 elements, sub and super parametric elements, coordinate 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.

5 Applications of FEM to Engineering problems (Software based course) (10)

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).

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	Elsevier
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,	PHI

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Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Advanced Design Engineering

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
ESE: 70 marks,
ISE: 30 marks,

Course Contents

SECTION-I

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 f low, Reynolds's equation with assumptions**.** **(5)**

4. Hydrodynamic journal bearing: Introduction to idealized full journal bearings, Load carrying capacity of idealized full journal bearings, Somerfield number and its significance, Numerical problems. **(5)**

SECTION-II

5. Introduction to Hydro static 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 We bull failure distribution function. Methods of improving reliability. Numerical problems **(6)**

7. Fatigue Analysis: Introduction, Fatigue strength, Factors affecting fatigue behavior, high cycle and low cycle fatigue, Cumulative damage in fatigue, and fatigue under complex Stresses **(7)**

8. Design for manufacturing and Assembly **(3)**

Text and reference books:

1. Theory of Machine s and mechanisms by J.E.Shigley (TMGH)
2. Mechanical Engineering Design by J.E Shigley (TMGH)
2. Dynamics of Machinery by Norton (TMGH)
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 KumarSrivastav (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.)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-II

M.Tech. Mechanical (Design Engineering) Syllabus W.E.F. 18-19

Industrial Product Design

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

Examination Scheme:
ESE: 70 marks
ISE: 30 marks
ICA-50marks

Course Contents

SECTION-I

1. **Introduction** **(6)**
   Need of Industrial design, Concept development process, Design and development process of industrial products, Assessing the quality of Industrial design, Problems faced by industrial designer, Types of models used in industrial design-Clay studies, Mock ups, scale models, Prototypes
2. **Industrial Product Design:** **(6)**
   Design of industrial and consumer products, setting specification, requirements and rating, their importance in the design. Study of market requirements and manufacturing aspects of industrial designs, Challenges of Product development.
3. **Aesthetic and Ergonomic Concepts:** **(8)**
   a. Concept of unity and order with variety, concept of purpose, style and environment. Aesthetic expressions of symmetry, balance, contrast continuity, proportion.
   b. Mechanics of seeing, psychology of seeing. Influence of line and form. Effect of color on product, appearance, reactions to color and color combinations. Man-Machine relationship, Use and limitations of anthropometric data, Aspects of ergonomic design of machine tools, testing equipments, instruments, automobiles, process equipments etc., interpretation of information, physiological factors, psychology factors, anatomy factors.

SECTION-II

4. **New Product Development**: **(4)**
   Initiation, Idea collection, creative design; brain storming; creative thinking; creative development, inventiveness; conception design. Function and use, Legal standard requirement; international standards, prototype design pre-production, inspection.
5. **Economic Considerations:** **(6)**
   Selection of material, Design for Production (DFP), impact of DFP on other factors, Use of standardization, value analysis and cost reduction, break even analysis.
6. **Design for Environment:** **(4)**
   Need, Guidelines**,** Product Life Cycle assessment, Techniques to reduce environmental impact
7. **Modern approaches to product design:** **(6)**
   Concurrent Design, Quality Function Deployment (QFD), computer aided industrial design, Rapid Prototyping,

Product Design Lab-

Course Outcomes:

At the end of the course, student will be able to

1. Analyze existing products for improvements
2. Design new products/devices using industrial design principals
3. Evaluate products for aesthetic/ergonomic concepts, cost and product life cycle

Lab Work –

1. Case Studies:- Design Analysis of existing products (Market survey, Need identification, etc)
2. Case Studies: Design of new product devices, utility products (Concept generation and evaluation using different methods)
3. Aesthetic and ergonomic evaluation of any one consumer product and suggesting improvements
4. One Case study on Product Life Cycle Assessment
5. One case study on cost analysis and cost reduction of industrial product

REFERENCE BOOKS

1. Product Design and development – Karl T. Ulrich, Steven D. Eppinger and Anita Goyal, McGill Education, 4th Edition.
2. Product Design – Kevin Otto and Kristin Wood, Pearson Education
3. Product Design and Manufacture- A. K. Chitale and R. C. Gupta, PHI Learning, 5th Edition
4. Industrial Design for Engineers – W. H. Mayall, London Liifee books Ltd.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19
Semester-II
Programme Elective II: (1) Theory and Analysis of Composite Materials

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme
ESE: 70 Marks
ISE: 30 Marks

Course Contents
SECTION-I

1. Introduction to Composite Materials: Definition, Classification, Types of matrix material sand reinforcements, Characteristics & selection, Fiber composites, laminated composites, Metal matrix composite, Particulate composites and Pre-pegs, Application of Composite Materials. **(4)**

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. **(8)**

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)**

SECTION-II

4. Macro-mechanical behavior of Laminate: Introduction, code, Kirch off hypothesis, Classical Lamination Theory, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Strength of Laminate, Inter-laminar Stresses. **(6)**

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, Types of defects. **(4)**

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 **(2)**

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, McGraw Hill Book Company, 1984.

Reference Books:

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19
Semester-II
Programme Elective II: (2) Engineering Design Optimization

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme
ESE: 70 Marks
ISE: 30 Marks

Course Contents
SECTION-I

1. **Introduction to Optimization**: Need for optimization and historical development, engineeringapplication 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. **(5)**
4. **Non Linear Programming**: One dimensional minimization methods, elimination methods, unrestricted search, exhaustive search, golden section method. **(6)**

SECTION-II

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. **(5)**
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:

1. Minimum eight assignments/tutorials based on above syllabus.

References:

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. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Semester-II

Programme Elective II: (3) Industrial Tribology

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme
ESE: 70 Marks
ISE: 30 Marks

Course Contents

SECTION-I

1. Classification and Selection of Bearings: (5)

Introduction, Dry and Boundary Lubrication Bearings, Hydrodynamic Bearing, Hydrostatic Bearing, Magnetic Bearing, Rolling Element Bearings, Selection Criteria, Bearings for Precision Applications, Noncontact Bearings for Precision Application, Bearing Subjected to Frequent Starts and Stops

2. Lubrication of Bearings: (6)

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).

3. Finite Bearings: (5)

Hydrostatic, Hydrodynamic and thrust oil bearings, heat in bearings.

4. Hydrostatic squeeze film: (4)

Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings.

SECTION-II

5. Elasto-hydrodynamic Lubrication: (7)

Pressure-viscosity term in Reynolds Equation, Hertz theory, Ertel-Grubin Equation, lubrication of spheres.

6. Hydrodynamic Bearings under Dynamic Conditions: (6)

Introduction, Analysis of Short Bearings under Dynamic Conditions, Journal Center Trajectory, Solution of Journal Motion by Finite-Difference Method.

7. Tribological Aspects of Rolling Motion: (7)

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.

Reference Books –

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

9. Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Programme Elective II: (4) Advanced Engineering Materials

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours / week	**ISE:** 30 marks
	ESE: 70 marks

Course Contents

SECTION-I

1. Introduction to ferrous and nonferrous alloys **(06)**

Types of steels, composition, properties applications, types of cast irons: composition, properties applications, Heat treatments of steels such as annealing, normalizing, Hardening & tempering, definition, concept, objectives. Copper alloys, Aluminum alloys, Titanium alloys, Magnesium alloys, Fusible Alloys.

2. Materials for powder metallurgy **(06)**

Manufacturing of metal/non metal powders (conventional and modern methods), Powder mixing and blending, Powder compaction, Mechanical, thermal and thermo-mechanical compacting processes, Sintering theories, mechanisms, types, variables, Secondary operations Performed on Powder Metallurgical components.

3. Composites and Nano materials **(08)**

Definition and characteristics, advantage and limitations of composite materials, Significance and objectives of composite materials, current status, Classification of composite materials, Constituent materials and properties, Properties of typical composite materials,

Nano materials - Definition, length scales, effect of particle size on thermal, mechanical, electrical, magnetic, and optical properties of the nanomaterial, Inspiration from Nature about nanotechnology. Synthesis of nanomaterial: Top down approaches like soft lithography, Bottom-up approaches like gas condensation, chemical vapor deposition.

SECTION-II

4. Electric - Magnetic Materials& its properties **(07)**

Electrical and Thermal Conduction in Solid metal and conduction by electrons, factors affecting electrical resistivity, Resistivity Mixture Rule, Skin Effect. Electrical Conductivity of Non-Metals: Ionic Crystals and Glasses, Semiconductors, Thermal Conductivity, Thermal Resistance, Magnetic properties and magnetic alloys, Soft and Hard Magnetic materials, Ferrites. Introduction to Shape Memory Alloys, properties and Applications.

5. Ceramic materials **(06)**

Introduction to ceramics, Comparison of properties with metals and polymers, bonding-covalent and ionic, important ceramics structures, Effect of Chemical Forces on Physical Properties: Melting Points, Thermal Expansion & Surface Energy. Chemical Equilibrium, Chemical Stability, Phase diagrams and their importance.

6. Polymer materials **(07)**

Types, properties and applications of of Plastics such as Thermoplasts and Thermo sets. Natural polymers like Rubber, Chemical Composition of the Rubber Phenolic and Amino Resins, Unsaturated polyester resins, Epoxy resins and Polyurethanes, silicone rubbers and miscellaneous thermosetting resins, Proteins, Protein structures etc

Text Books:

1. C. Barry Carter, M. Grant Norton, Ceramic Materials- Science and Engineering, Second Edition, Springer New York, 2013
2. M. N. Rahaman, Ceramic Processing and Sintering, 2nd edition, Marcel Dekker Inc., NY,2003.
3. William F. Smith - Foundation of Materials Science and Engineering, McGraw-Hill International Edition, 2nd Edition, 1993.
4. N. Braithwaite and G. Weaver - Materials in Action Series -Electronic Materials, Butterworth's Publication
5. B.S. Murty and P, Textbook of Nanoscience and Nanotechnology by. Shankar, Universities Press (India) Private Limited, 2012, 1st Edition.
6. Guozhong Cao, Nanostructures and Nanomaterials: Synthesis, Properties & Applications by, Imperial College Press, 2004, 2nd Edition.
7. Gabor L. Hornyak, H.F. Tibbals,Introduction to Nanoscience and Nanotechnology
8. Joydeep Dutta, John J. Moore, CRC Press, 2008, ISBN-13: 978-1420047790
9. Anish Upadhayaya ,Gopal S. Upadhayaya, Powder Metallurgy: Science, Technology, and Materials, Universities Press, 2011.
10. Randall German, Powder Metallurgy Science, Metal Powder Industry; 2 Sub edition, 1994.
11. S. K. Bashin &Rekha, Introductory Polymer Science ,**Publisher** : Mann
12. Malcom P. Stevens, Polymer Chemistry- An Introduction

Reference Books:

1. Schroder, Klaus, Electronic Magnetic and Thermal properties of Solids, Marcel Dekker, New York1978.
2. Nanoscale Materials in Chemistry edited by Kenneth J. Klabunde and Ryan M. Richards,2nd edition, John Wiley and Sons, 2009.
3. Randall German, Sintering Theory and Practice, Wiley-Inter science; 1 edition, 1996.
4. ASM Handbook: Volume 7: Powder Metal Technologies and Applications, 2nd edition, 1998.
5. W.D. Callister, Materials Science and Engineering 8th Edition, 2006.

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Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Program Elective –III: (1) Engineering Fracture Mechanics

Teaching Scheme:
Lectures: 3 Hrs per week

Examination Scheme
ESE: 70 marks
ISE: 30 marks

Course Contents
SECTION-I

1. Introduction:-
Kinds of failure, historical aspects, brittle and ductile fracture, modes of fracture failure. **(4)**

2. **Fracture Criteria:**
Griffith criterion, Irwin's Fracture Criterion, Stress Intensity Approach, Stress intensity factor, Surface energy, energy release rate, crack resistance, R curve for brittle crack, stable and unstable crack growth, critical energy release rate **(8)**

3. Stress intensity factor:-
Stress and displacement fields, edge cracks, embedded cracks, SIF for different geometry, critical stress intensity factor **(8)**

Section-II

4: Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement **(7)**

5. Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral: clip gauge, load displacement test, etc. **(7)**

6. Fatigue mechanics: -S-N diagram, fatigue limit, fatigue crack growth rate, Paris law, Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques. **(6)**

References:–

1. Anderson T.L., Fracture Mechanics, 2nd Edition, CRC Press, 1995
2. Broek David, Elementary Engineering Fracture Mechanics, 3rd Rev. Ed. Springer, 1982.
3. Prashant Kumar, Elements of fracture mechanics, McGraw hill Education (I) Pvt., Ltd.

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Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Programme Elective -III: (2) Project Management

Teaching Scheme:
Lectures: 3 Hrs per week

Examination Scheme
ESE: 70 Marks
ISE: 30marks

Course Contents

SECTION-I

Unit-1.Introduction to Project management**:** Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization **(6)**

Unit-2. Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks **(8)**

Unit 3: Project Management tools: Use of at least one tool - viz. **(6)**
Microsoft Project / HTPM (Harvard Total Project Manager)/ Primavera
Use of tools to make Gantt Charts, PERT charts and allocation of resources etc, Project Crashing Project Finance.

SECTION-II

Unit-4 .Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Leveling and Resource Allocation. Time Cost Trade off: Crashing Heuristic. **(6)**

Unit-5. Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management and materials management. Post-Project Analysis. **(8)**

Unit-6. Management of Special Projects. Management of SE/NPD/R&D/Hi-Tech/Mega Projects **(6)**

Text Books/References:

1. Shtub,BardandGloberson,ProjectManagement:Engineering,Technology,andImplementation,Prentice Hall, India
2. Lock, Gower, Project Management Handbook.
3. Project Management by Nagarajan.
4. All students are advised to Harvard business school press publications on the web or at the library to read further.
5. Prof.(Ms.) Karuna Jain, Shailesh J Mehta School of Management, IIT Bombay. (http://nptel.iitm.ac.in Project Management- Video course)

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Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Programme Elective-III: (3) Design for Manufacturing and Assembly

Teaching Scheme:
Lectures: 3 Hrs per week

Examination Scheme
ESE: 70 marks
ISE: 30 marks

Course Contents

SECTION-I

1. **Introduction:** General design principles for manufacturability: strength and mechanical factors, mechanisms selection, evaluation method, Process capability: Feature tolerances, Geometric tolerances, Assembly limits, Datum features, and Tolerance stacks. **(4)**

2. **Factors Influencing form Design:** Working principle, Material, Manufacture, Design- Possible solutions, Materials choice, Influence of materials on form design, form design of Welded members, forgings and castings**.** **(8)**

3. **Component Design-I:**Machining Consideration: Design features to facilitate machining drills, milling cutters, keyways, Doweling procedures, counter sunk screws, Reduction of machined area, simplification by separation, simplification by amalgamation, Design for machinability, Design for economy, Design for clampability, Design for accessibility, Design for assembly. **(8)**

SECTION-II

4. **Component Design-Casting** Consideration: Redesign of castings based on parting line considerations, Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, group technology, Computer Applications for DFMA. **(10)**

5. **Design for the Environment:** Introduction, Environmental objectives, Global issues Regional and local issues, Basic DFE methods, Design guide lines, Example application, Lifecycle assessment, Basic method, Environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for disassembly, Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards. **(10)**

Text and Reference Books

1. Product Design- **Author**: Kevien Otto and Kristin Wood **Publisher**: Pearson Publication
2. Product design and development **Author**: K.T. Ulrich and S.D. Eppinger **Publisher**: Tata McGraw Hill
3. 1980 Design for Assembly Automation and Product Design **Author**: Boothroyd, G **Publisher**: Marcel Dekker.
4. Design for Manufacture handbook **Author** : Bralla **Publisher**: McGraw Hill

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Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Programme Elective -III: (4) Analysis and Synthesis of Mechanism and Machines

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme
ESE: 70 Marks
ISE: 30marks

Course Contents

SECTION-I

1. Basic Concepts: Definition s 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, kinetic, static 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- Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell Mechanisms. **(5)**

SECTION-II

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 forfour 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. **(6)**

Reference Books:

1. Theory of Machines and Mechanisms, A. Ghosh and A.K.Mallik, Affiliate d 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 I 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.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Semester-II

M. Tech.-Mechanical (Design Engineering) Syllabus W.E.F 2018-19

Seminar- II

Teaching Scheme: Not Applicable **Examination Scheme**

Practical: 2 Hrs./week. **ICA:** 50 Marks

The objective of seminar II

1. It should be helpful to understanding methodology review of other researcher in selected topic. And able to formulate research objective and methodology for probable topic of dissertation.
2. It is expected students seminar I and II will help students to finalize his/her area of research, methodology, tools techniques and make students able to write synopsis which has to submit in Semester III.

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 A4sized 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.

Guidelines lines for Seminar II report writing.

Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Different steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing –References – Tables – Figures – Conclusion – Appendices.

Punyashlok Ahilayabai Holkar Solapur University, Solapur

M.Tech. (Mechanical- Design Engineering) Semester-III

Open Elective Course- Operations Research

Teaching Scheme	**Examination Scheme**
Lectures –3 Hours/week, 3 Credits	ESE- 70 Marks
	ISE- 30 Marks

Course objective:-The course aims to train the students -

1. To formulate the appropriate O.R. model
2. To use quantitative techniques in solving the real life problems
3. To evaluate alternative courses of actions in actual decision making under conditions of uncertainty.

Course outcome:- At the end of this course the students shall be able to

1. Formulate the real life managerial problems in an appropriate mathematical model
2. Provide the optimum solution to the real life problems within the constraints.
3. Use network techniques in project management
4. To evaluate alternative courses of actions in actual decision making under conditions of uncertainty using Simulation techniques.

SECTION-I

Unit 1: **(5 Hrs)**
OR Models, model formulation, Linear Programming models, Graphical solution, Simplex techniques, Two Phase method

Unit 2: Duality theory - Properties of Primal and Dual Optimal Solutions, Duality Simplex method , Shadow Price- Sensitivity analysis (5 Hrs)

Unit 3: Simulation Techniques - Need of Simulation techniques , Monto-Carlo Simulation, random number concept, applications of Simulation technique (5 Hrs.)

Unit 4: Queuing Models - Introduction, Structure of queuing system, Terminology (Kendal‘s Notations) and Applications. Queuing Model M/M/1: /FIFO, (3 Hrs.)

SECTION II

Unit 5 : Inventory control - Inventory costs, Economic order quantity, deterministic models with or without shortages - probabilistic models - Price break model, Selective Inventory management techniques. (5 Hrs.)

Unit 6: Replacement analysis - Replacement models - Replacement policy for items considering change in money value with time - Individual replacement policy - Group replacement policy (5 Hrs.)

Unit 7: Network flow models - Minimal Spanning Tree problems -Shortest route probems - Dijiktra's algorithm - Maximal Flow problem (3 Hrs.)

Unit 8 : PERT and CPM Networks - floats and applications -
Network crashing - Cost optimization - Resource allocation and scheduling (5 Hrs.)

- **In Semester Evaluation (ISE)**
  ISE shall be based upon minimum 5 assignments and at least one case study.

Reference Books

1. Operations Research by Hillier and Lieberman TMGH
2. HamdyTaha, “Operations Research – An Introduction”, 7th edition PHI (2003)
3. S. D. Sharma, “Operation Research”, Kedarnath and Rannalt Pub.
4. Hira and Gupta, “Operation Research”, S. Chand and Co.
5. N. D. Vohra, “Quantitative Techniques in Management”, TMGH
6. Shrinath L.S.: PERT & CPM –Affiliate East West Press
7. Anand Sharma " Quantitative Techniques for decision making" Himalaya publishing house
8. Billy E. Gillet - " Introduction to Operations Research" TMGH
9. R. Panneerselvan " Operations Research" PHI
