GOVERNMENT COLLEGE OF ENGINEERING
KARAD

(*An Autonomous Institute of Government of Maharashtra*)

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULA FOR
M.TECH DESIGN ENGINEERING
W.E.F
AY 2024-25

COURSE SYLLABUS

FOR

FIRST YEAR

M TECH IN DESIGN ENGINEERING

SEMESTER I

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE 2102: Stress Analysis

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials			ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): students will be able to -

1.	Students will understand the tensorial approach of continuum mechanics and comprehend modern research material.
2.	Student will apply basic field equations such as equilibrium equations, compatibility and constitutive relationship.
3.	Students will be able to apply basic field equations to torsion, bending and two dimensional problems, energy methods and plastic hinges.
4.	Students will be proficient in using FEM software packages with framing correct boundary conditions.
5.	

	Course Contents	Hours
Unit 1	**Continuum & Tensors:** Stress tensor, Differential equations of equilibrium, Boundary conditions, Stress functions and Bi-harmonic equation	**(06)**
Unit 2	Displacement and strains, compatibility,	**(06)**
Unit 3	Conservation Laws, Constitutive relations and Linear Elasticity,	**(06)**
Unit 4	**Two dimensional problems:** Rectangular coordinates and polar coordinates , Applications to polynomials in rectangular coordinates, Saint-Venant's principle, General equations in polar coordinates,Strain components in polar coordinates, Torsion: Torsion of bars with elliptical square and rectangular cross section Membrane analogy, Hydro dynamical analogy, Torsion of hollow and thin tubes, Bending: Bending of Beams,pure bending of curved bars, Rotating discs, stresses in a circular , Energy methods, Shear centre: Shear stress distribution and shear centre for thin walled open sections.	**(08)**
Unit 5	**Plasticity in structures**: Introduction to elastic stability, Plasticity	**(06)**
Unit 6	**Thick cylinders and Disks, Contact stresses** Shells and vessels of uniform strength, Problem of determining contact stresses, Assumption Expressions for principal stresses, Examples.	**(07)**

Tutorials

Text Books

1.	Sadd, Martin H., Elasticity: Theory, applications and Numerics, Academic Press 2005
2.	Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 2000
3.	Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999

Reference Books

1.	Popov, E.P., "Engineering Mechanics of Solids", 2nd Ed., Prentice Hall India,1998.
2.	S. Timoshenko and J.W. Goodier "Theory of Elasticity" MGH book coLtd
3.	Chakrabarty, "Theory of Plasticity", McGraw-Hill Book Company, New York1990.
4.	Sadhu Singh – Theory of Elasticity, Khanna Publisher.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	3	2	3		3	3	3	3		3	2	2	2	
CO 2				2			3	1	3						2
CO 3		3		2		3	1					1	1		2
CO 4			1	3	3	2	3	3	1	2				3	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE2113: Elective I Advanced Mathematical methods in Mechanical Design

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): students will be able to -

1.	Apply methods of Applied Linear Algebra in engineering design
2.	Solve problems involving Nonlinear Optimization in engineering. .
3.	Simulate engineering systems using Numerical Methods
4.	Model the physical systems using Differential Equations

	Course Contents	Hours
Unit 1	**Mathematical Modeling:** Modeling of systems related to mechanical engineering, assumptions, appropriate methods and fundamental of a computer implementation	**(7)**
Unit 2	**Numerical Linear Equations:** Introduction, Basic Ideas of Applied Linear Algebra, Systems of Linear Equations, Square, Non-Singular Systems, the Algebraic Eigenvalue Problem, Matrix Decompositions, Computer implementation of the methods for applications in engineering analysis.	**(7)**
Unit 3	**Outline of Optimization Techniques:** Introduction to Optimization, Multivariate Optimization, Constrained Optimization, Optimality Criteria, Computer implementation of the methods for applications in design optimization, manufacturing and thermal process optimization. es	**(7)**
Unit 4	**Topics in Numerical Analysis**: Interpolation, Regression, Numerical Integration, Numerical Solution of ODE's as IVP Boundary Value Problems. Application of numerical methods for research in mechanical engineering.,	**(7)**
Unit 5	**Overviews: PDE's and Variational Calculus:** Separation of Variables in PDE's, Hyperbolic Equations, Parabolic and Elliptic Equations, Membrane Equation, and Calculus of Variations. Applications in mechanical engineering research.	**(5)**
Unit 6	**Testing of Statistical Hypothesis:** Testing a statistical hypothesis, tests on single sample and two samples concerning means and variances. ANOVA: One – way, Two – way with/without interaction	**(7)**

Text Books

1	E. Kreyszig , Advanced Engineering Mathematics, Wiley, 2010
2.	Giancarlo Genta, Dynamics of Rotating Systems, Springer, 2009

Reference Books

1.	M. T. Heath, Scientific Computing, McGraw-Hill Education, 2001..
2.	B. Dasgupta , Applied Mathematical Methods, Pearson Education, 2006.
3	Steven Chapra, Applied Numerical Methods with Matlab, McGraw-Hill Education, 2011.

Useful Links

1.	https://oldweb.nitw.ac.in/media/uploads/2019/09/10/md.pdf

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE2123: Experimental Stress Analysis

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) The students will be able to

1.	Apply principles of brittle coating for stress analysis
2.	Illustrate usage of different stress analysis methods.
3.	Employ correct stress analysis method for a particular situation.
4.	Analyze stress in mechanical component using photo elasticity method

	Course Contents	Hours
Unit 1	**Introduction:** Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations. Strain measurement methods: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.	**(7)**
Unit 2	**Recording Instruments:** Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.	**(7)**
Unit 3	**Brittle Coatings:** Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data. Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometarical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques	**(7)**
Unit 4	Photo Elasticity: Photo elasticity, polariscope, plane and circularly polarized light, right and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.	**(7)**
Unit 5	Three Dimensional Photo Elasticity: introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered light method Birefringent coating: Introduction, coating stress and stains, coating sensitivity, coating materials, application of coatings, effective of coating thickness, fringe-order determinations in coatings, stress separation methods.	**(7)**
Unit 6	Residual Stress Analysis: Analytical and numerical solution of residual stresses in metal working processes (autofrettage, welding etc.), Experimental methods for assessing residual stresses: Sachs boring, X-ray diffraction, neutron diffraction and hole drilling method, inference of residual stresses from microhardness test.	**(5)**

Text Books

1. JW Dally and WF Riley, “Experimental Stress Analysis”, McGrawHill Publications, 2003

Reference Books

1. CC Perry and HR Lissner, “The Strain Gage Primer”, McGrawHill, 2000.
2. Abdul Mubeen, “Experimental Stress Analysis”, DhanpatRai and Sons, 2001.
3. PS Theocaris, “Moire Fringes in Strain Analysis”, Pergammon Press, 2002.
4.

Useful Links			
1.	http://nptel.ac.in		

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1										3	3	2	
CO 2	1														2
CO 3	1	2										1	2		1
CO 4		1	1									1		3	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE2133: Mathematical Modeling for Mechanics and Dynamics

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): students will be able to -

1.	Apply mathematical tools for modeling of systems and their analysis
2.	Develop mathematical models for simple mechanical systems
3.	Simulate mathematical models using classical as well as numerical approach.
4.	Create / Visualize mathematics behind mechanical phenomena

	Course Contents	Hours
Unit 1	Differential equation: ODE and PDE Formulation and solution of ordinary and partial differential equations, One dimensional diffusion equation, Wave equation, Laplace equation	**(7)**
Unit 2	**Numerical analysis:** Curve fitting, root finding, RK methods, Finite Difference methods, explicit and implicit finite difference schemes, stability of finite difference methods, application of finite difference methods in boundary value problems.	**(7)**
Unit 3	**Transforms:** Concept of transforms, Fourier transforms, discrete Fourier transforms, Laplace transforms and its inverse. Laplace transforms of special functions: Unit step, Unit impulse, periodic and error, Application to initial value problem and wave equations using transform techniques.	**(7)**
Unit 4	Sampling mean and variance, sampling distributions based on normal estimation, properties of point estimators, confidence interval, maximum likelihood and Bayes estimators, prediction intervals.	**(7)**
Unit 5	**Development of empirical models** Development of dimensionless models for mechanical systems. Design of experiments: experimental designs, analysis tools, interpretation. Basic statistics, ANOVA, RSM to optimize performance and use of statistical softwares such as MINITAB.	**(7)**
Unit 6	Development of mathematical models and its simulation using numerical tools, differential models, empirical models	**(5)**

Text Books				
1.	Advanced engineering mathematics by Ervin Kreyszig			
2.	Mathematical methods of statistics by H. Cramer			
3.	'Research Methodology: Methods and Trends', by Dr. C. R. Kothari			
Reference Books				
1.	Essential mathematical models for physicists by Hans. J. Weber			
2.				
Useful Links				
1.	http://nptel.iitm.ac.in			

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2		1	3	3	3		2	3	3	3	
CO 2	1			3	2		3	3	1					3	3
CO 3	3	1		2		3	2					1	3		3
CO 4	2		2	2	2	1	3	3	3	1				2	

Assessment Pattern(with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	4	10
Understand	-	4	10
Apply	5	4	15
Analyse	5	4	10
Evaluate	5	4	15
Create	-	-	-
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE2143: Reliability Engineering

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To prepare the students to succeed as designer in industry/technical profession.
2.	To provide student knowledge of reliability and maintainability of machines and systems.
3.	To train the students to apply knowledge of probability for reliability analysis of machines and mechanisms.
4.	To prepare the students to use reliability theory for product life calculation and for maintenance of machines and mechanical systems.

	Course Contents	Hours
Unit 1	**Module 1:** Introduction, History, definition, application of reliability, Reliability function R(t), Probability density distribution function f(t) , Cumulative probability distribution function F(t), Hazard rate function Z(t), Mean time to failure, Mean time between failures.	**(7)**
Unit 2	**Module 2:** Brief revision of probability mathematics, Relation between R(t), f(t), F(t), Z(t) etc. , Hazard rate models, Life cycle of the product, Bath tub curve, Failure analysis for discrete data	**(7)**
Unit 3	**Module 3:** Probability distribution used in reliability, Exponential, Rayleigh, Normal, Binomial, Weibull distribution, Calculation of R(t), Z(t), MTTF for above distributions, identifying failure distributions, Probability plots, Least square curve fitting methods	**(7)**
Unit 4	**Module 4:** Failure mode analysis, fault three and success three methods, symbols used, tie sets, cut sets, failure mode effectiveness and criticality analysis.	**(7)**
Unit 5	**Module 5:** Reliability of the systems- series, parallel and redundancy (active, standby) systems, mixed , complex systems.	**(7)**
Unit 6	**Module 6:** Introduction to maintainability-MTTR, Availability, Reliability design of elements, strength and duty distribution, factor of safety, simples examples of design of elements with reliability such as tension element, I beam, shaft subjected to torsion etc. Reliability testing-product testing, life testing, bum in testing, acceptance testing, accelerated life testing, reliability growth.	**(5)**

Text Books

1.	Birolini, Alessandro, "*Reliability Engineering",* Springer, Fourth Edition, 2004.
2.	Modarres M, KaminskiyM, "*Reliability Engineering and Risk Analysis-A Practical Guide",* CRC Press, Second Edition, 2010.

Reference Books

1.	Chrles E. Ebiting, "*Introduction to Reliability, Maintainability Engineering*", Tata McGraw Hills Pvt Ltd.,1980.

2.	K.C. Kapoor, L.R. Laimberson, "*Reliability in Engineering Design*", John Wiley & sons,1977.
3.	S.S.Rao, "*Reliability Based Design*", Tata McGraw Hills, 1st edition, 1980.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1		2	2	1	2		3	3	3	3	
CO 2	2			3	3		2	3	2						2
CO 3		1		3		3	3					1	3		1
CO 4			2	1	1	1	1	2	1	3				2	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE2114: Advanced Machine Design

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To strengthen fundamentals of applied mechanics of solids and build understanding of design
2.	To design mechanical components subjected to static loading
3.	To design and analyse mechanical components subjected to dynamicloading.
4.	For the design and analysis of components students will be able to incorporate effect of crack and creep

	Course Contents	Hours
Unit 1	**Module 1:** **Review of Stresses, Strains and Theories of Failures:** Introduction, Plane Stress, Rotation of Coordinate Axes, Generalized Plane Stress, Principal Stresses and Maximum Shear Stress, 3D state of stress, Stresses on Octahedral plane, Plane strain, Strain gage rosettes.	**(7)**
Unit 2	**Module 2:** Introduction to basic Constitutive Relations and Rheological Models: Elastic (Generalized Hooke's Law), Plastic (Rigid-Perfectly Plastic, Elastic-Perfectly, Elastic-Linear Hardening), Creep (Steady state and Relaxation, Transient), Anisotropic and Orthotropic Hooke's Law, Theories of Failures: Distortion Energy, Maximum- Shear Stress, Maximum Normal Stress, Modified Coulomb-Mohr Theory, Comparison of theories of failures.	**(7)**
Unit 3	**Module 3:** **Fracture Mechanics:** Introduction, Rise in stresses due to crack, Crack tip opening displacement, LEFM: Effect of crack on strength of ductile and brittle material, Crack opening modes and Griffith theory, Concept of *SIF* and *K* Crack Tip Plasticity, Use of *K* in design and analysis, Determination of plastic zone, size and shape, Limitations of LEFM.	**(7)**
Unit 4	**Module 4:** **Fatigue:** Introduction, factors affecting fatigue behaviour, Theoretical stress concentration factor and notch sensitivity factor, Fatigue under complex stresses, cumulative fatigue design, Linear damage (Miner's Rule), Manson's method, Fatigue crack propagation and life estimation for constant and variable amplitude stress	**(7)**
Unit 5	**Module 5:** **Surface Failures:** Friction: Rolling, Effect of roughness, velocity and lubrication on friction, Wear: Adhesive, Abrasive and Corrosive, Lubrication: Hydrodynamic, hydrostatic and elsatorydrodynamic lubrication, Surface Fatigue, Contact Stresses: Spherical, Cylindrical, General and Dynamic, Surface Fatigue Strength, design to avoid surface fatigue.	**(7)**
Unit 6	**Module 6:** **Creep and Damping:** True stress and true strain, Creep phenomenon, Creep Curve, Creep parameters, time-temperature parameters and life estimate: Sherby- Dorn and Larson-Miller, Stress relaxation. Stress-Strain-Time relation, Creep deformation under varying stress, Component stress- strain analysis, Energy dissipation in materials.	**(5)**

Text Books

1.	Mechanical Behaviour of Materials: Engineering Methods for Deformation Fracture an Fatigue4\e N E Dowling Pearson.
2.	Machine Design: An Integrated Approach 3\e R L Norton Pearson Education
3.	Fundamentals of Machine Design 5\e R C Juvinall& K M Marshek Wiley India

Reference Books	
1.	Mechanical Design of Machine Elements and Machines: A failure prevention perspective J ACollins, H Busby and G Stabb Wiley India.
2.	Dislocations and Mechanical Behaviour of Materials M. N. Shetty PHI.
3.	Mechanical Behaviour of Materials, 2\e T H Courney McGraw-Hill / Overseas Press India.

Mapping of COs and POs

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CO 2	2			3	3		2	3	2						2
CO 3		1		3		3	3					1	3		1
CO 4			2	1	1	1	1	2	1	3				2	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

MD2124: Elective II Fatigue, Fracture and Failure Analysis

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Student will be able to understand an overview of mechanical behavior includes tensile, fatigue and creep behavior of materials.
2.	Student will be able to understand the micro mechanisms of brittle and ductile fracture
3.	Students will be able to analyze the fatigue and fracture behavior of materials
4.	Students will be able to apply the knowledge for failure analysis and case studies

	Course Contents	Hours
Unit 1	**Role of Failure Prevention Analysis in Mechanical Design**: Introduction, Definition of design, challenge and some design objectives. **Modes of Mechanical Failure:** Definition of failure mode, failure modes observed in practice, a glossary of mechanical failure modes	**(8)**
Unit 2	**Introduction to Fracture Mechanics:** Introduction of the basic concepts of linear elastic and elastic-plastic fracture mechanics, stress intensity parameter, J- integral and crack tip opening displacement as fracture criteria.	**(7)**
Unit 3	Introduction to fatigue **High-Cycle Fatigue:** Introduction, historical remarks, nature of fatigue, fatigue loading, laboratory fatigue testing, the S-N-P curves, factors that affect S-N-P curves, , the influence of nonzero mean stress.	**(6)**
Unit 4	**Low-Cycle Fatigue:** Introduction, the strain cycling concept, the strain life curve and low cycle fatigue relationships, cumulative damage rule in low-cycle fatigue	**(6)**
Unit 5	**Cumulative Damage, Life Prediction and Fracture Control:** Introduction, the Linear damage theory, cumulative damage theories, life prediction based on local stress-strain and fracture mechanics concepts.	**(7)**
Unit 6	Micro mechanisms of brittle and ductile fracture, fracture mechanism maps, fractography, Visual Examination & Management of Applied Failure Analysis, Manage Failure Analysis. case studies in fatigue and fracture mechanics	**(6)**

Reference Books

1.	Failure of Materials in Mechanical Design: Analysis, Prediction, Prevention, J. A. Collins, John Wiley & Sons, Inc.,1981
2.	Fracture Mechanics: Fundamentals and Applications, T. L. Anderson, CRC Press, 3rd edition, 2013
3.	Metals Hand Book 9th Edition,Vol. 11,Failure Analysis and Prevention

Text Books

1.	Elements of Fracture Mechanics: Prashant Kumar, Wheeler Publishing , 2013
2.	Metal Fatigue in Engineering, Ralph I. Stephens, Wiley publication 2nd Edition,2000

Mapping of COs and Pos

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CO 1	3											3	2	1	3
CO 2	3	2										3	2	2	3
CO 3	3	2	2	2								3	2	2	2
CO 4	3	2	2	2								2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	4	10
Understand	-	4	10
Apply	5	4	15
Analyse	5	4	10
Evaluate	5	4	15
Create	-	-	-
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

DE2134: Tribology

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials			ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	The students will be able to apply theories of friction and wear to various practical situations by analysing the physics of the process.
2.	They will understand the various surface measurement techniques and effect of surface texture on Tribological behaviour of a surface.
3.	They will be able to select materials and lubricants to suggest a tribological solution to a particular situation.
4.	The students will be able to design a hydrodynamic bearing using various bearing charts.
5.	The students will be able to understand the recent developments in the field and understand modern research material.

	Course Contents	Hours
Unit 1	Friction, theories of friction, Friction control, Surface texture and measurement, genesis of friction, instabilities and stick-slip motion.	**(06)**
Unit 2	Wear, types of wear, theories of wear, wear prevention.	**(06)**
Unit 3	Tribological properties of bearing materials and lubricants.	**(06)**
Unit 4	Lubrication, 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), Finite Bearings, Design of hydrodynamic journal bearings	**(06)**
Unit 5	Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings.	**(06)**
Unit 6	Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel-Grubin equation, lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings,	**(06)**

Text Books

1.	Cameron, "Basic Lubrication Theory", Ellis Horwood Ltd, 1981.
2.	Principles in Tribology, Edited by J. Halling, 1975
3.	Fundamentals of Fluid Film Lubrication – B. J. Hamrock, McGraw Hill International,1994
4	D.D. Fuller, "Theory and Practice of Lubrication for Engineers", John Wiley and Sons, 1984.

Reference Books

1.	"Fundamentals of Friction and wear of Materials" American Society of Metals.
2.	Introduction to Tribology of Bearings –B. C. Majumdar, A. H. Wheeler & co. pvt. ltd 1985.
3.	T.A. Stolarski, "Tribology in Machine Design".

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	3		2	2	2	3		3	3	3	2	
CO 2	2			3	2		2	3	3						3
CO 3	3	3		1		2	2					3	3		1
CO 4	2		1	2	1	3	1	3	1	3				1	
CO 5			3		2	1	3	1		3	2	1	3	2	1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

Final Year (Sem –VIII) B. Tech. Mechanical Engineering

DE2144: MEMS and Nanotechnology

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		**MSE**	**20**
Tutorials	-			
Total Credits	03		**ISE**	**20**
			ESE	**60**
			Duration of ESE	02 Hrs.30 Min

Course Outcomes (CO)

Students will be able to

1.	Understand concept of micro-nano systems.
2.	Apply engineering knowledge to different processes of micro-nano systems manufacturing.
3.	Appraise the working principles of various micro sensors and micro actuators.
4.	Design a micro system and develop a process sequence for its manufacturing.

	Course Contents	Hours
Unit 1	**Overview and Introduction** New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.	**(06)**
Unit 2	**MEMS Fabrication: Bulk Lithography** Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching.	**(06)**
Unit 3	**MEMS Fabrication: Surface Micromachining** Surface micromachining: Working Principle of Surface Micromachining, Surface micromachining materials, Surface micromachining layers, Fabrication process of surface micromachining, advantages and disadvantages, applications. Case study: Surface Micro machined accelerometer, Nano electro mechanical relays.	**(08)**
Unit 4	**MEMS Fabrication: LIGA and Micro-Nano Stereo lithography** High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems's packaging, Essential packaging technologies, Selection of packaging materials. Micro-Nano Stereo lithography: need of micro stereo lithography and limitations of conventional processes, System components of micro stereo lithography, Methods of Micro stereo lithography, Need of nano stereo lithography, Recent trends in nano stereo lithography.	**(08)**
Unit 5	**Micro Sensors & Micro Actuators** MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators	**(08)**
Unit 6	**Design Aspects of Micro-Nano Systems** Applications of MEMS in Cantilever sensors, Emulsion equipment, Humidity sensor, Liquid lenses, Micro spectrometer.	**(04)**

Tutorials- -- Assignments on each Unit- 6 Nos.

Text Books

1.	"MEMS", Nitaigour Premchand Mahalik, TMH Publishing corporation,1st Edition,2014
2.	"Springer Handbook of Nanotechnology", Bharat Bhushan, Springer, Berlin, Heidelberg, 2nd Edition,2006.
Reference Books	
1.	"Fundamentals of Micro fabrication", Marc Madou, CRC press 1997.
2.	"Micro system Design", Stephen D. Senturia, Kluwer Academic Publishers,2001.
3.	"MEMS and Microsystems Design and Manufacture", Tai Ran Hsu, Tata McGraw Hill, 2002.
4.	"Foundations of MEMS", Chang Liu, Pearson education India limited, 2006.
5.	"MEMS and NEMS: Systems, Devices, and Structures", Sergey Edward Lyshevski , CRC Press, 2002.
Useful Links	
1.	https://www.me.iitb.ac.in/~gandhi/me645/05L13_muSL.pdf
2.	http://www.nanolab.t.u-tokyo.ac.jp/pdffiles/060815ASPE-kajiwara.pdf
3.	https://www.slideshare.net/navinec1/micro-electromechanical-system-mems

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2											2	2	1	3
CO 2	3	2	1	1								2	1	2	3
CO 3	3	3	2	1								1	2	2	3
CO 4	3	3	2	1								1	1	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – I) Design Engineering

RM 2105: Research Methodology

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	The students will be able attend Research Problem
2.	The students will be able to handle data analysis and experimental instrumentations
3.	The students will be able to carry out modelling and performance prediction of linear and nonlinear models
4.	The students will be able to develop a research proposal

	Course Contents	Hours
Unit 1	**Research Problem** Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem	**(7)**
Unit 2	**Basic instrumentation** Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.	**(7)**
Unit 3	**Applied statistics** Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis, Probable errors in the research, Error analysis	**(7)**
Unit 4	**Data Analysis:** Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	**(7)**
Unit 5	**Modelling and prediction of performance** Setting up a computing model to predict performance of experimental system, Multi-scale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.	**(7)**
Unit 6	**Developing a Research Proposal** Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research.	**(5)**
Tutorials		

1.	Assignment on
2.	MATLAB simulation on Data Analysis
3.	MATLAB simulation on DOE analysis
4.	Assignment on preparation of Research Proposal
5.	Assignment on statistics
6	Assignment on Modeling and Prediction
Text Books	
1.	'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard
2.	'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville
3.	'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition
Reference Books	
1.	'Research Methodology: Methods and Trends', by Dr. C. R. Kothari
2.	'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & co.
Useful Links	
1.	http://nptel.iitm.ac.in

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2		1	3	3	3		2	3	3	3	
CO 2	1			3	2		3	3	1					3	3
CO 3	3	1		2		3	2					1	3		3
CO 4	2		2	2	2	1	3	3	3	1				2	
CO 5			3		3	3	1	1		1	1	3	2	2	1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad				
M Tech-First Year (Sem – I) Design Engineering				
DE 2106: Lab Practice - I				
Teaching Scheme			**Examination Scheme**	
Practical	04 Hrs/week			
Tutorials	00 Hrs/week		ISE	25
Total Credits	02		ESE	25

Course Outcomes (CO)

1.	The students will be able to measure experimentally principal strain and stresses using strain gauges
2.	The students will be able to measure experimentally vibration signals and carry out FFT analysis
3.	The students will be able to measure experimentally conduct condition monitoring and fault diagnosis of machine component using FFT and Noise signal analysis
4.	The students will be able to measure experimentally conduct modal analysis using vibration shaker

	Course Contents	Hours
Experiment No 1	Measurement of strain using strain gauge on mechanical component and determine a force deflection curve using DAQ system	**(2)**
Experiment No 2	Measurement of acceleration using accelerometer on vibrating machine, Conducting FFT analysis of signals received from sensor	**(2)**
Experiment No 3	Condition Monitoring and Fault Diagnostics of Vehicle components using FFT Analyzer	**(2)**
Experiment No 4	Measurement of Noise spectrum of Machine and estimation of noise level using noise sensor	**(2)**
Experiment No 5	Modal analysis of prismatic sections (1-DoF, 2-DoF and Distributed Parameter System) using vibration excitation table	**(2)**
Experiment No 6	Conduction of Literature Survey and Development of Research Proposal	**(2)**
Experiment No 7	Modal Analysis and Spectrum (FFT) Analysis of Engine Component using FFT analyzer and Vibration Shaker Table	**(2)**
Experiment No 8	Experimental Measurement of Principal stress and Principal strain using Strain Rosset of Cantilever Beam	**(2)**

Useful Links	
1.	http://nptel.iitm.ac.in

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	1		1	2	3	3		3	3	3	2	
CO 2	1			3	2		3	3	2					3	3
CO 3	3	3		3		3	2		3			3	2		1
CO 4	2		2	3	1	3	3	3	3	2				3	
CO 5			3		3	1	2	1		2	1	3	2	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember		3	3
Understand		4	4
Apply		4	5
Analyse		4	3
Evaluate		4	4
Create		6	6
TOTAL		25	25

Government College of Engineering, Karad				
M Tech-First Year (Sem – I) Design Engineering				
DE2107: Lab Practice – II				
Teaching Scheme			**Examination Scheme**	
Practical	04 Hrs/week			
Tutorials	00 Hrs/week		ISE	25
Total Credits	02		ESE	25

Course Outcomes (CO)

1.	The students will be able to simulate Single DoF vibration problem
2.	The students will be able to carry out numerical simulation of vibration problems
3.	The students will be able to conduct static and dynamic FEA simulation of Machine components
4.	The students will be able to simulate linear and nonlinear optimization problem

	Course Contents	Hours
Experiment No 1	Simulation of Single DoF vibration problem: Free, Forced, damped and Unddamped and also verify law of conservation in spring mass damper system	**(2)**
Experiment No 2	Numerical Simulation of Linear and Nonlinear ODE (may be simple pendulum or spring mass damper system) using RK method and MATLAB ODE solvers	**(2)**
Experiment No 3	FEA Static Simulation of Machine Component	**(2)**
Experiment No 4	FEA Modal as well as Harmonic Simulation of Machine Component	**(2)**
Experiment No 5	Simulation of Simplex Optimization Problems and its graphical simulation using MATLAB	**(2)**
Experiment No 6	Simulation of Nonlinear Optimization of problems using MATLAB	**(2)**
Experiment No 7	Simulation of Principal Stresses and Principal Planes and graphical representation using MATLAB	**(2)**
Experiment No 8	Contact FEA simulation using ANSYS	**(2)**

Useful Links

1.	http://nptel.iitm.ac.in

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	1		1	2	3	3		3	3	3	2	
CO 2	1			3	2		3	3	2					3	3
CO 3	3	3		3		3	2		3			3	2		1
CO 4	2		2	3	1	3	3	3	3	2				3	
CO 5			3		3	1	2	1		2	1	3	2	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember		3	3
Understand		4	4
Apply		4	5
Analyse		4	3
Evaluate		4	4
Create		6	6
TOTAL		25	25

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical Engineering

ME OE2118:- Business Analytics

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	-		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	demonstrate knowledge of data analytics.
2.	evaluate data and deep analytics using critical thinking in decisions making.
3.	Apply technical skills in predicative and prescriptive modeling to support business decision-making.
4.	Analyse data into clear, actionable insights.

	Course Contents	Hours
Unit 1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.	**(09)**
Unit 2	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple LinearRegression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology**.**	**(08)**
Unit 3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	**(09)**
Unit 4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	**(5)**
Unit 5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	**(5)**
Unit 6	Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	**(04)**

Text Books

1.	Business analytics third edition by Pearson

Reference Books

1.	Business Analysis by James Cadle et al.
2.	Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical Engineering

ME2128:- Industrial Safety

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	-		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	Realize the basics of Occupational Health Hazards.
2.	Introduce about common occupational diseases
3.	Define industrial hygiene and principles.
4.	Get acquainted with the principles of ergonomics.

	Course Contents	Hours
Unit 1	Introduction and Scope (20) Definition of Occupational Health as per WHO/ILO. Occupational Health and Environmental SafetyManagement – Principles practices. Common Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers,medical surveillance for control of occupational diseases and health records.	**(6)**
Unit 2	Monitoring for Safety, Health and Environment (20) Occupational Health and Environment Safety Management System, ILO and EPA Standards. Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures. Chemical Hazard: Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Route of entry to human system, recognition, evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values.	**(8)**
Unit 3	Occupational Health and Environmental Safety Education Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit	**(7)**
Unit 4	Occupational Safety, Health and Environment Management Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM.	**(7)**
Unit 5	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.	**(7)**
Unit 6	Importance of Industrial safety, role of safety department, Safety committee and function, Role and responsibilities of safety officer	**(5)**

Reference Books

1.	Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2.	Maintenance Engineering, H. P. Garg, S. Chand and Company.
3.	Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

4.	Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Design Engineering

OE 2138: Operations Research

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

At the end of the course, the students will able to

1.	apply the dynamic programming to solve problems of discreet and continuous variables.
2.	apply the concept of non-linear programming
3.	carry out sensitivity analysis
4.	model the real-world problem and simulate it.

	Course Contents	Hours
Unit 1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	**(06)**
Unit 2	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	**(07)**
Unit 3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	**(06)**
Unit 4	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	**(06)**
Unit 5	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	**(07)**

Text Books

1.	J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
2.	Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3.	Pannerselvam, Operations Research: Prentice Hall of India 2010

Reference Books

1.	H.A. Taha, Operations Research, An Introduction, PHI, 2008
2.	H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3.	Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Mapping of COs and POs

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CO 1	3	3	3	2		1	3	3	3		2	3	3	3	
CO 2	1			3	2		3	3	1					3	3
CO 3	3	1		2		3	2					1	3		3
CO 4	2		2	2	2	1	3	3	3	1				2	
CO 5			3		3	3	1	1		1	1	3	2	2	1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Design Engineering

OE:2148 Cost Management of Engineering Projects

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials				
Total Credits	03		ISE	20
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) : At the end of course students will able to

1.	Understanding of cost management process
2.	Applications of project management in context with cost
3.	Quantitative techniques for cost management

	Course Contents	Hours
Unit 1	Introduction and Overview of the Strategic Cost Management Process	**(10)**
Unit 2	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database foroperational control; Provision of data for Decision-Making.	**(08)**
Unit 3	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	**(08)**
Unit 4	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision- making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing.	**(08)**
Unit 5	Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control;	**(08)**
Unit 6	Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisionalprofitability pricing decisions including transfer pricing. Quantitative techniques for cost management, PERT/CPM, Linear Programming, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	**(08)**

Text Books

1.	Cost Accounting A Managerial Emphasis, Prentice Hall of India, NewDelhi
2.	Charles T. Horngren and George Foster, Advanced Management Accounting
3.	Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

Reference Books

1.	Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
2.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical Engineering

ME OE1158:- Composite Materials

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	-			
Total Credits	03		ISE	20
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	demonstrate knowledge of composite materials and its importance in todays world.
2.	Students will be able to plan the processing of composite materials
3.	select correct reinforcement and matrix for perticular application
4.	demonstrate knowledge of preparation technologies of composite materials

	Course Contents	Hours
Unit 1	INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	**(7)**
Unit 2	REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	**(7)**
Unit 3	Manufacturing of Ceramic matrix composite; Metal Matrix Composites:Metal matrix and reinforcement; Manufacturing processes for Metal Matrix Composites:Dispersion hardended and particle composite; Manufacturing processes for Meta matrix composites:Layer composites and in¬ltration method.	**(6)**
Unit 4	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	**(6)**
Unit 5	Prevention of Damage, repair of Composites and selection of processes; Ceramic matrix composites: Hot isostatic processing ; Non – destructive testing of Composites; Manufacturing process selection: Cost, performance, size shape, rate of production. Steps for process selection,green composite.	**(7)**
Unit 6	Nano composites Nanocomposite-What is Nanotechnology? Importance of length scale, meaning of NANO, uniqueness of nano structured materials, polymer nanomaterials , different types of Nanoparticles, Synthesis of nanocomposite, APPLICATIONS: High temperature applications : fire retardant , flame retardant nanocomposite applications, Thermoset nanocomposites for rocket ablative materials, nanomodified carbon-carbon composites, green composites, recent trends in nanocomposites.	**(7)**

Text Books

1.	Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2.	Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3.	Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books

1.	Hand Book of Composite Materials-ed-Lubin.
2.	Composite Materials – K.K.Chawla.
3.	Composite Materials Science and Applications – Deborah D.L. Chung.
4.	Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Design Engineering

OE :2168 Waste to Energy

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	-			
Total Credits	03		ISE	20
			ESE	60
			Duration of ESE	2 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	
2.	
3.	

	Course Contents	Hours
Unit 1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue,Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	**(07)**
Unit 2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields andapplication – Manufacture of pyrolytic oils and gases, yields and applications.	**(06)**
Unit 3	Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic considerationin gasifier operation.	**(07)**
Unit 4	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	**(06)**
Unit 5	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status -Bio energy system - Design and constructional features - Biomass resources and their classification	**(07)**
Unit 6	Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urbanwaste to energy conversion - Biomass energy programme in India.	**(08)**

Text Books

1.	Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990
2.	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, TataMcGraw Hill Publishing Co. Ltd., 1983.
3.	Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Reference Books

1.	Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.

Useful Links

1.	Moocs/ Swayam Courses on Waste to Energy

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Design Engineering

AU 2119: Research Paper Writing (Audit Course – 1)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	--
Tutorials	-		ISE	--
Total Credits	00		ESE	--
			Duration of ESE	--

Course Outcomes (CO)

At the end of the course students will able to:

1.	Understand that how to improve your writing skills and level of readability.
2.	Learn about what to write in each section.
3.	Understand the skills needed when writing a Title

	Course Contents	Hours
Unit 1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	**(04)**
Unit 2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	**(04)**
Unit 3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**(04)**
Unit 4	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	**(04)**
Unit 5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	**(04)**
Unit 6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	**(04)**

Tutorials- --

Text Books

1.	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2.	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

Reference Books

1.	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
2.	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Design Engineering

AU 2129: Disaster Management (Audit Course – I)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	--
Tutorials	-		ISE	--
Total Credits	00		ESE	--
			Duration of ESE	--

Course Outcomes (CO)

At the end of the course, the students will:

1.	learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
2.	critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives
3.	develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

	Course Contents	Hours
Unit 1	**Introduction** Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	**(04)**
Unit 2	**Repercussions of Disasters** and **Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. **Natural Disasters**: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, **Man-made disaster**: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	**(04)**
Unit 3	**Disaster Prone Areas in India** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases And Epidemics	**(04)**
Unit 4	**Disaster Preparedness and Management** Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.	**(04)**
Unit 5	**Risk Assessment** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques at Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival	**(04)**
Unit 6	**Disaster Mitigation** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	**(04)**

Tutorials- --

Text Books

1.	R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2.	Sahni, Pardeep Et.Al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3.	Goel S. L., Disaster Administration and Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Design Engineering

(Audit I) AU2139 Sanskrit for Technical Knowledge

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	20
Tutorials				
Total Credits	00		ISE	20
			ESE	60
			Duration of ESE	2 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Introduction to Vedic language
2.	Technical information about Sanskrit Literature
3.	Vedic mathematics

	Course Contents	Hours
Unit 1	Alphabets in Sanskrit, Past/Present/Future Tense,Simple Sentences	**8**
Unit 2	Order Introduction of roots Technical information about Sanskrit Literature	8
Unit 3	Technical concepts of Engineering-Electrical, Mechanical, Architecture,Mathematics	8

Text Books

1.	"Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2.	"Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam,New Delhi Publication

Reference Books

1.	"India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Useful Links

1.	Swayam/ NPTEL Courses

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical-Design Engineering

(Audit I) AU2149 Value Education

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	20
Tutorials	-			
Total Credits	00		ISE	20
			ESE	60
			Duration of ESE	2 Hrs 30 Min.

Course Outcomes (CO)

Students will be able to

1.	Knowledge of self-development
2.	Learn the importance of Human values
3.	Developing the overall personality

	Course Contents	Hours
Unit 1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision ofhumanism. Moral and non- moral valuation. Standards and principles. Value judgements	**07**
Unit 2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature ,Discipline	07
Unit 3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrityand discipline. Punctuality, Love and Kindness. Avoid fault Thinking.	07
Unit 4	Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits.	08
Unit 5	Association and Cooperation.Doing best for saving nature Character and Competence –Holy books vs Blind faith.Self-management and Good health. Science of reincarnation.	07
Unit 6	Equality, Nonviolence ,Humility, Role of Women.All religions and same message. Mind your Mind, Self-control.Honesty, Studying effectively	06

Text Books

1.	Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press,New Delhi

Useful Links

1.	NPTEL/ Swayam Courses dedicated to value Education.

Government College of Engineering, Karad

First Year (Sem – I) M. Tech. Mechanical- Design Engineering

DE 2110: Finite Element Analysis

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): students will be able to -

1.	Understand the fundamentals of fundamentals of Finite Element Analysis and Variational Principles
2.	Analyse 1D structural and heat transfer problems
3.	formulate 2D FEA problems
4.	Solve and analyse Dynamic problems using FEA

	Course Contents	**Hours**
Unit 1	Introduction to FEM, basic concepts, historical background, applications of FEM, general description, comparison of FEM with other methods, variational approach, Galerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.	**(04)**
Unit 2	1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions, and problems. Analysis of Trusses: Plane Trusses and Space Truss elements and problems Analysis of Beams: Hermite shape functions – stiffness matrix – Load vector – Problems.	**(10)**
Unit 3	2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Iso- parametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. 3-D Problems: Tetrahedron element – Jacobian matrix – Stiffness matrix.	**(10)**
Unit 4	Steady state heat transfer, 1 D heat conduction governing equation, Boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, Heat flux boundary condition	**(04)**
Unit 5	Formulation for point mass and distributed masses, Consistent element mass matrix of one-dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix, Evaluation of Eigen values and Eigen vectors, Applications to bars, stepped bars, and beams. Introduction to FES software Packages, Algorithmic approach for developing the code by the individuals	**(08)**
Unit 6	Non-linear Analysis - Sources and types of non-linearity, Incremental approach to solution of nonlinear problems, Iterative solution methodologies, Considerations for simulation of non-linear problems.	**(04)**

- **Tutorials/ assignments**
- Implementation of FEA MATLAB programs on
  - 1D structural analysis
  - 1D Heat Transfer problem
  - 1D dynamic analysis
- Implementation of FEA using commercial ANSYS package
  - Stress analysis of bracket
  - Structural analysis of pump analysis for rigidity analysis
  - Heat Transfer and Thermal stress analysis of Engine Block
  - Contact analysis

Text Books	
1.	Rao S. S. "Finite Elements Method in Engineering"- 4th Edition, Elsevier,2006
2.	J.N. Reddy, "Finite Element Method"-McGraw-Hill International Edition
3.	Bathe K. J. Finite Elements Procedures, PHI. Cook R. D., et al. "Concepts and application of Finite Elements Analysis"-4th Edition, Wiley &Sons,2003.
4.	Chandrupatla T.R., "FiniteElementsinengineering"-2nd Editions, PHI,2007.2.
5.	Frank L. Stasa," Applied finite Element Analysis for Engineers", CBS International Edition,1985.
Reference Books	
1.	Zeinkovich, "The Finite Element Method for Solid and Structural Mechanics, 6th Ed., Elsevier2007.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	2	2		2	2	2	2	2	2	2
CO 2	3	3	2	3	3	2	1	1	2	1	1	2	3	3	2
CO 3	3	3	3	2	2	2	1	1	2	1	1	2	3	2	3
CO 4	3	3	2	2	2	1	1		3	1	1	2	3	3	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

COURSE SYLLABUS

FOR

FIRST YEAR

M TECH IN DESIGN ENGINEERING

SEMESTER II

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

DE 2202: Computer Aided Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Understand the fundamentals of Geometric modelling
2.	Develop and manipulate the curves and surfaces using parametric equations
3.	Implement the transformation and projection over the geometric model
4.	Develop and manipulate the solid models using different modelling approaches

	Course Contents	**Hours**
Unit 1	Introduction: Definitions, Historical developments. Geometric Modeling, Nameable Unnamable shapes, Affine and convex combination. Introduction to Equations - Implicit, explicit, parametric. Coordinate systems	**(04)**
Unit 2	Design of Curves: Cubic Hermite curves - Algebraic and geometric forms, Blending functions, Subdivision, Reparameterization, Truncating, Extenuating and subdividing. Space curve, four point form, straight line and Composite Hermite curves (C^n and G^n continuity).Spline curve, Bezier curves - Control polygons and Bernstein basis, De Casteljau algorithm, First and second derivatives at the ends, Continuity aspects. B-Spline Curves - periodic, open and non-uniform knot vectors and corresponding curves, Rational B-splines, NURBS, and Quadratic variety.	**(10)**
Unit 3	Design of surfaces: Hermite Surface - Algebraic and geometric form, tangent and twist vectors, Normal, parametric space of a surface, blending functions, Subdivision and Reparameterization, Continuity of surfaces. Sixteen point form , four curve form, plane surface, cylindrical surface, ruled surface, surface of revolution. Bezier surface - Control net representation, Direct and indirect De Casteljau algorithm for Bezier surface, Continuity aspects. B-Spline Surfaces - periodic, open and non-uniform knot vectors and corresponding surfaces, Rational B-splines, NURBS.	**(10)**
Unit 4	Transformations in 2D and 3D, Translation, Rotation, Scaling Symmetry and Reflection, affine transformation. Homogeneous Transformation. Orthotropic projections, Axonometric Projections, Oblique Projections, perspective Transformations.	**(04)**
Unit 5	Introduction to Solid Modelling - Topology of closed paths, piecewise Flat surface, Topology of closed curved surfaces, Generalised concept of boundary, set theory, Boolean operators(Union, Difference and Intersection) , Set memberships classification, Euler and modified form of equations. Solid model construction: Graph based methods, Boolean models, Instances and parameterised shapes, Cell decompositions, Representations - Quadtree, Octree, Half space, sweep, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG)	**(08)**
Unit 6	Introduction to analytical properties, relational properties and intersections, data transfer formats for Cad. Applications	**(04)**

Tutorials/ assign ments

Implementations of the algorithms on MATLAB such as:

- Hermite curve
- Hermite/Bezier surface
- B-spline curve/surface)
- 2D Transformation
- Construction of solid and surface Models on any of the high end solid modellers (Nx 11.0, solid

	works)

Text Books				
1.	Geometric Modelling, Michael E. Mortenson			
2.	Mathematical Elements of Computer Graphics, David Rogers and Alan Adams			
3.	Curves and Surfaces for CAGD, Geral E. Farin			
4.	Introduction to Solid Modelling, Martii Mantyla			
5.	CAD CAM Theory And Practice , Ibrahim Zeid			
Reference Books				
1.	The NURBS Book. Piegel.Tiller			

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	2	2		2	2	2	2	2	2	2
CO 2	3	3	2	3	3	2	1	1	2	1	1	2	3	3	2
CO 3	3	3	3	2	2	2	1	1	2	1	1	2	3	2	3
CO 4	3	3	2	2	2	1	1		3	1	1	2	3	3	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) Design Engineering

DE 2213: Mechatronics and Control Systems (Elective-III)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Understanding working of principles of Sensors, actuators
2.	Understanding concepts of Data Acquisition System
3.	Understanding and implementation of control system
4.	Understanding and developing practical control systems

	Course Contents	Hours
Unit 1	Overview of measurement systems Measurement devices; Classification of sensors. Characteristics and calibration of different sensors. **Displacement position and motion sensors**: Principles of variable resistance, variable inductance, variable reluctance, and variable capacitance type sensors. Position and Motion sensors: Limit switches; Proximity sensors: Pneumatic Proximity sensor; Optical Proximity sensor; Inductive Proximity sensor; Capacitive Proximity sensor; Ultrasonic Proximity sensor **LVDT:** construction; working principle, signal conditioning; use of LVDT The Tachogenerator: DC Tachogenerator, Digital Tachogenerator; Optical type and magnetic type, Synchros and resolver. Encoders: types of encoder; **Hall sensors:** Working principle; Hall effect gear tooth sensor, Distance sensors **Light Sensor:** Photovoltaic; Photoconductive (Photo resistors) **Accelerometer:** Definition; General Construction; Working Principle; Types of Accelerometer Servo Type; Piezo Resistive Type; Capacitive Type; Variable reluctance type; Errors; Variable reluctance circuit geometry ; Auto null sensor amplifier; force balance servo sensor.	**(06)**
Unit 2	**Strain Gauges:** Working principle; construction, poisson's ratio; Gauge factor, Piezo resistance Coefficient: strain sensing alloys; characteristics; gauges length, rosettes; Pressure sensor: Definition on pressure, Static, head, dynamic pressure. Classification of pressure; **Application of Diaphragm:** Capacitance Type. Reluctance Type, Strain Gauge Type and Inductive Type. **Application of Bellows**: Differential pressure; Pneumatic Servo mechanism type. Electrical and Piezoelectric pressure transducers, McLeod gage, Pirani gage and Ionisation gage **Flow sensors:** The flow pioneers Reynolds numbers, principle of flow measurement Head type flow meter, Electromagnetic flow meter, Rotameter, Anemometer, Ultrasonic flow meter **Smart Sensor:** Methods of internal compensation, information coding, integrated sensor principles, present trends	**(06)**
Unit 3	**Analog Signal Conditioning:** Introduction, Principles of Analog Signal conditioning, Signal-level Changing, linearization, Conversions, Zero adjustment, Span adjustment, Filtering and Impedance Matching, Passive Circuit, Driver Circuit, Bridge Circuits, RC Fitters Operational Amplifiers, Characteristic Op Amp circuits in Instrumentation, voltage follower, Differential Amplifier, Instrumentation amplifier, Active Filters. Voltage-to-Current Converter, Current-to-voltage Converter. Linearization **Digital Signal Conditioning:** Review of digital Fundamentals, Busses and Tri-State Buffers, Converters, Comparators, Digital-to- Analog Converters (DAC), Analog-to-Digital Converters (ADCs), Sample and Hold, Multiplexer and De-multiplexer, decoder and encoder, Pulse modulations, Digital recorder, Programmable Logic Controller **Data Acquisition System:** Introduction, Analog arid Digital Data Acquisition Systems, Block diagram, Components, CPU, Memory, input / Output, sensors, ADC, DAC Sample and Hold, Multiplexing and De-multiplexing, Modulation, Display, Recording, alarm Programming, Voltage, Current, Frequency,	**(06)**
	Temperature. Displacement, Pressure measurement using Data Acquisition System (DAS), Application of Data Acquisition System in Power plant, Project control plant and Automation, Data logger	

Unit 4	**Basic control schemes and controllers:** On - off Control, Time proportional control, PI Control; PD Control; PID Control. Controller: Block diagram Types of controllers; Sell operated controllers; Electronic controller; Analog controller; Pneumatic controller, comparison between Pneumatic & electronic controller, Hydraulic Controller; Programmable logic Controller (PLC)	**(08)**
Unit 5	**Modern Control:** Concepts of states, State variable and state models linear continuous time and discrete time, state space models, similarity transformation, transform function to state space representation controllability and stabilizability, absorbability and detectability canonical decomposition, polo assignment by state feedback, Observers, continuing state feedback with an observer	**(06)**
Unit 6	**Non-Linear Control System:** Introduction, Common physical nonlinearities. The phase — plane method, singular points, Stability of non-linear system, Construction of phase — trajectories, System analysis by phase plane method, The describing function method, Derivation of describing function, Stability analysis by describing function methods, Jump resonance Liapunov's stability criterion.	**(07)**

Tutorials	
1.	Interfacing sensors to microcontroller (Arduino, Raspberry PI)
2.	Commanding to Actuators (stepper motor, DC motor) through Arduino or Raspberry Pl
3.	study of Signal Processing (Bit accuracy, bit width and Sampling)
4.	Experiments on dSPACE DS1104 microcontroller
5.	Design of PID control system using MATLAB programming

Text Books	
1.	Ramesh S. Gaonkar, Microprocessor Architecture Programming and Applications", New Age International publishers Ltd.
2.	W. Bolton, "Mechatronics" Pearson Education, 4th Edition, 2008
3.	Mahalik, "Mechatronics", TATA McGraw Hill, 2006

Reference Books	
1.	K. P. Ramachandran, "Mechatronics: Integrated Mechanical Electronic Systems (WIND)" Wiley, 2008
2.	K. K. Appukuttan, "lntroductlon to Mechatronics", Oxford University Press, 2007
3.	Godfrey C. Onwubolu, "Mechatronics: Principles and Applications, Elsevier; First edition 2006
4.	Hackworth, "Programmable Logical Controller", Pearson Education, 2008

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) Design Engineering

DE2223: Mechanisms and robotics

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) The students will be able to

1.	Will be aware of the state of the art technology and vocabulary/terminology used2 in this subject.
2.	to develop analysis and synthesis procedures for different mechanism
3.	to interpret and express3D motion using mapping and transformation procedures
4	design and develop Kinematic model for manipulators

	Course Contents	Hours
Unit 1	Introduction, Automation and Robotics. Robotics in Science Fiction, Progressive Advancement. The Robotics trends and the future prospects. Fundamentals of Robot Technology	**(7)**
Unit 2	Robot Anatomy – Links, Joints and Joint Notation scheme, Degrees of Freedom (DOF), Required DOF in a Manipulator. Arm Configuration, Wrist Configuration; The End-effector, Human arm characteristics, Design & Control issues. Precision of Movement, Manipulation & Control, Robotics sensors; Robot specification, Robot programming & work cell control.	**(7)**
Unit 3	Analysis & modeling of mechanisms: Mechanisms, Special Mechanism, Four bar planar and Special Mechanism, Mathematical models of simple mechanisms.	**(7)**
Unit 4	Robot Motion Analysis: ntroduction to co-ordinate frames; mappings, Description of objects in space, Transformation of vectors - Rotation & Translation of vectors, Composite transformations. Homogeneous Transform, Fundamental Rotation Matrices; Examples	**(7)**
Unit 5	Kinematics Manipulators: Kinematic Modeling of Manipulator, Direct kinematics model mechanical structure & Notations Description of links & Joints. Denavit-Hertenberg Notation, kinematic Relationship between links, Manipulator transformation matrix, Examples of direct Kinematics	**(7)**
Unit 6	Robot end- effectors: Types of end-effectors, methods of holding, Mechanical grippers,; Consideration in gripper selection & design, Gripping Force Differentia kinematics, linear and angular velocity, Relationship between Transformation matrix and angular velocity, mapping velocity vectors, velocity propagation along links. Manipulator Jacobian, Jacobian Inverse, Jacobian singularities, Static Analysis, Examples	**(5)**

Text Books

1.	(T) Mittal R. K. & Nagrath, I. J., “Robotics and Control”, TMH, 2003

Reference Books

1.	Groover, M. P., et al., “Industrial Robotics”, McGraw Hill ISE, 1986
2.	Fu, K. S., et al., Robotic: Control, Sensing, Vision & Intelligence, McGraw Hill ISE, 1987
3.	Robert J., Schilling, Fundamentals of Robotics: Analysis and Control, Prentice Hall, NJ, 2002.

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1		2	3	1	2		3	3	3	2	
CO 2				1			2	1	1						2
CO 3		2		3		2						1	2		1
CO 4			1	1	1	2		2	2	3				3	
CO 5	1		2		2	2	2	3		2	2	3	2	1	2

Assessment Pattern **(with revised Bloom's Taxonomy)**

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) Design Engineering

DE2233: Prototyping and 3D printing

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) The students will be able to

1.	need of design for additive manufacturing
2.	Develop mathematical models to represent synthetic curves and surfaces
3.	Identify design constraints and choose a polymer and metal AM process
4	Apply design for additive manufacturing guidelines in designing mass customised products

	Course Contents	Hours
Unit 1	**Introduction to Design for Additive Manufacturing (DfAM):** Introduction to geometric modelling, Modelling of Synthetic curves like Hermite, Bezier and B-spline, Parametric Representation of freeform surfaces, Design freedom with AM, Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DfAM tools, Requirements of DfAM methods, General Guidelines for DfAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing	**(7)**
Unit 2	**Design Guidelines for Part Consolidation:** Design for Function, Material Considerations, Number of Fasteners, Knowledge of Conventional DFM/DFA, Assembly Considerations, Moving Parts, Part redesign, Opportunities for part consolidation, challenges with part consolidation	**(7)**
Unit 3	**Design for Improved Functionality:** Multi scale design for Additive manufacturing, Mass customization, Biomimetics, Generative design, Design of multi-materials and functionally graded materials	**(7)**
Unit 4	**Design for Minimal Material Usage:** Topology Optimization, Modelling of Design space, defining design and manufacturing constraints, performing analysis for weight reduction, maximize stiffness, minimize displacement, Post-processing and Interpreting Results, Applications of TO, TO tools, Design of cellular and lattice structures, Design of support structures.	**(7)**
Unit 5	**Computational Tools for Design Analysis:** Considerations for Analysis of AM Parts, Material Data, Surface Finish, Geometry, Simplifying Geometry, Mesh-Based Versus Parametric Models, Build Process Simulation: Model Slicing, Contour Data Organization, Layer-by-Layer Simulation, Hatching Strategies, Scan Pattern Simulation and Tool Path Generation.	**(7)**
Unit 6	**Design for Polymer AM:** Anisotropy, Wall Thicknesses, Overhangs, Support Material, Accuracy, Tolerances, Layer Thickness, Resolution, Print Orientation, Warpage, over sintering, Hollowing Parts, Horizontal Bridges, Connections, Fill Style, holes, fillets, ribs, font sizes and small details	**(5)**

Text Books

A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, and Damien Motte, Springer, 2020.

The 3D Printing Handbook: Technologies, Design and Applications, Redwood, Ben, Filemon Schoffer, and Brian Garret, 3D Hubs, 2017

Reference Books

1.	Design for Advanced Manufacturing: Technologies and Process, Laroux K, Gillespie, McGrawHill, 2017
2.	Additive Manufacturing Technologies, Gibson, Ian, David W. Rosen, Brent Stucker, and Mahyar Khorasani, Springer, 2021

3.	Laser-Induced Materials and Processes for Rapid Prototyping, L.Lu, J. Y. H. Fuh and Y.S. Wong, Springer, 2001

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1		2	3	1	2		3	3	3	2	
CO 2				1			2	1	1						2
CO 3		2		3		2						1	2		1
CO 4			1	1	1	2		2	2	3				3	
CO 5	1		2		2	2	2	3		2	2	3	2	1	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem –II) Design Engineering

DE2243: Internet of things and Machine Learning

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) The students will be able to

1.	Build schematic for IoT solutions .
2.	Design and develop IoT based sensor systems
3.	Apply probabilistic approach real life problems
4	Understand the various techniques in machine learning

	Course Contents	Hours
Unit 1	**Introduction to IoT components:** Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardwares, Examples of IoT infrastructure	**(7)**
Unit 2	**IoT protocols and softwares:** MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP,XMPP and gateway protocols, IoT security: Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security	**(7)**
Unit 3	**IoT point to point communication technologies:** IoTCommunication Pattern, IoT protocol Architecture, Selection of Wireless technologies (6 LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA,Lifi,Widi)	**(7)**
Unit 4	PROBABILITY Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence. UNIT II: RANDOM VARIABLES Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality	**(7)**
Unit 5	STOCHASTIC PROCESSES Introduction to Stochastic Processes (SPs), Stationary Processes, Discrete-time Markov Chains (DTMCs), Continuous-time Markov Chains (CTMCs)	**(7)**
Unit 6	LINEAR ALGEBRA Finite dimensional vector spaces over a field; linear combination, linear dependence and independence; basis and dimension; inner-product spaces, linear transformations; matrix representation of linear transformations	**(5)**

Text Books

Reference Books

1.	Sheldon Ross, A First Course in Probability, 7th Edition, Pearson, 2006
2.	J. Medhi, Stochastic Processes, 3rd Edition, New Age International, 2009.
3.	Stephen H Friedberg, Arnold J Insel, Lawrence E. Spence, Linear Algebra. 4th Edition, Pearson, 2006

Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1		2	3	1	2		3	3	3	2	
CO 2				1			2	1	1						2
CO 3		2		3		2						1	2		1
CO 4			1	1	1	2		2	2	3				3	
CO 5	1		2		2	2	2	3		2	2	3	2	1	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) M. Tech. Mechanical- Design Engineering

DE 2214: Non-linear and Random Vibrations

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To prepare the students to succeed as designer in industry/technical profession.
2.	To provide student knowledge of reliability and maintainability of machines and systems.
3.	To train the students to apply knowledge of probability for reliability analysis of machines and mechanisms.
4.	To prepare the students to use reliability theory for product life calculation and for maintenance of machines and mechanical systems.

	Course Contents	**Hours**
Unit 1	**Introduction:** Definition of non-linear systems and comparison between the behavior of linear and nonlinear systems. Undamped and damped free and forced vibrations. Self-excited oscillations, singular points, analytical methods. Stability concept, phase plane plots, limit cycle.	**(7)**
Unit 2	**Probability Theory:** Random Vibrations - Probability distribution and density functions - Excreted values - Conditional probability - Characteristic and log characteristic functions - Chebycshev inequality - Functions of random variables.	**(7)**
Unit 3	**Random Processes - I:** Concept of stationary and ergodicity - Evolutionary nonostationary process - Auto and cross correlation and covariance Functions - Mean square limit, differentiability and inerrability - Spectral decomposition.	**(7)**
Unit 4	**Random Processes - II:** Power spectral and cross spectral density Factions - Wiener - Khintchine relations - Properties of Gaussian. Poisson and Markov processes –Fokker - Planck Equation - Broad band and narrow band random processes - white noise.	**(7)**
Unit 5	**Random Vibrations - I:** Response of linear single and multi - degree of freedom systems to stationary excitation - Response of continuous systems - Normal mode method.	**(7)**
Unit 6	**Random Vibrations - II:** Level crossing, peak and envelop statistics - First excursion and fatigue.	**(5)**

Text Books

1.	Lishakoff, I., " Probabilistic Methods in the Theory of Structures", John Wiley, New York, 1983.
2.	Newland, D.E., " An Introduction to Random Vibrations and Spectral Analysis", Longman Inc., New York, Second Edition, 1984.

Reference Books

1.	Nigam, N.C., "Introduction to Random Vibrations". MIT Press, Cambridge, Massachusettes, 1983

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	3	1		2	1	3	2		3	2	3	2	
CO 2	2			3	2		3	3	1					3	3
CO 3	1	2		2		1	1	1	3	2		3	2		2
CO 4	2		3	3	1	3	3	1	1	2				2	
CO 5			1		1	3	2	2		2	2	2	3	2	1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) M. Tech. Mechanical- Design Engineering

DE 2224: Condition Monitoring

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To prepare the students to succeed as designer in industry/technical profession.
2.	To provide students with a sound foundation in noise and vibration control to & solve the problems in process industry.
3.	To train the students with good design engineering breadth required for safe and efficient design, construction, installation, inspection, testing and certification of machines.
4.	To aware the students about application of monitoring methods for preventive maintenance.

	Course Contents	Hours
Unit 1	**Module 1:** Introduction: Definition, Need and relevance to maintenance, Different techniques and their practical applications. Maintenance Principles, FMECA, Fault Prognosis.	**(5)**
Unit 2	**Module 2:** Vibration and AE based condition monitoring, Measurement of vibration and acoustic emission – Measuring parameters, Transducers, selection of appropriate parameters and transducers. Data acquisition and signal processing: A/D converters, Filters.	**(8)**
Unit 3	**Module 3:** Analysis and interpretation of vibration and AE data, Time & Frequency domain analysis, Analysis of stationary and non-stationary signals- FFT, Wavelet Transform, Hilbert Transform, Cepstrum analysis in machine condition monitoring, Modulation and Sidebands, Order Analysis, Orbits.	**(7)**
Unit 4	**Module 4:** Oil & wear debris analysis and ferrography: Principles, methods and instruments for wear debris analysis and ferrography.	**(7)**
Unit 5	**Module 5:** NDT, Ultrasonic, Eddy Current testing- Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection.	**(7)**
Unit 6	**Module 6:** Condition monitoring of various machine components and machines like bearings, gears, pumps, compressors, turbines, machine tools, cutting tools, etc. to diagnose various defects. Machinery prognostics, prediction of failures, concept of integrated analysis, Failure Analysis	**(6)**
Tutorials		
Text Books		

1.	Randall R. B., "Vibration Based Condition Monitoring," Ch.1, Ch. 2, Ch 3, Wiley, New Delhi, 2010
2.	J. H. William and others, "*Condition Based Maintenance and M/C Diagnostics*", Business & economics, 2nd edition, 1994.
3.	Alan Davies, "Handbook of Condition Monitoring: Techniques & Methodology," Chapman & Hall, London, 1998

Reference Books

1.	J.H. Williams, A. Davies, P.R. Drake, "Condition-based Maintenance and Machine Diagnostics" Springer Science & Business Media, 31-Jul-1994

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	2	2		3	1	2	1		2	2	3	1	2
CO 2	2	2		3	2		3		3					2	3
CO 3	1	1		3		1	3	1	3	2		3	2		3
CO 4	2		3	1	3	2	2	2	3	2				3	
CO 5			3		2	1	2	2		1	2	2	3	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem –II) M. Tech. Mechanical- Design Engineering

DE 2234: Synthesis of Mechanisms

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To prepare the students to succeed as designer in industry/technical profession
2.	To provide students with a sound foundation in kinematic and synthesis of machines and Mechanisms
3.	To train the students to apply complex number, matrices and algebra for analysis of Mechanisms
4.	To prepare the students to use modern software for kinematic and dynamic analysis of the mechanisms.

	Course Contents	Hours
Unit 1	**Module 1:** Kinematics in elements in pairs, Mechanisms with higher and lower pairs, Dimensional synthesis of mechanisms, Chebyshov-polynomials, Spacing of accuracy points.	**(7)**
Unit 2	**Module 2:** Four bar coupler points curves- Equation of coupler curves, Robort Chebyshov theorem, double points and symmetry, Euler Savary equation and cube of stationery curvature.	**(7)**
Unit 3	**Module 3:** Geometric Methods of synthesis of planner Mechanisms- Two finitely separated link positions, three separate link positions, poles and relative poles, Synthesis with three accuracy points, four finitely separated link positions, pole triangle, image poles, opposite poles, quadrilateral circle points and center points curves, synthesis with four accuracy point.	**(7)**
Unit 4	**Module 4:** Algebra method of synthesis of planer mechanisms – Displacement equations of the four bar linkage, synthesis with three accuracy points , synthesis with prescribed velocity and acceleration, synthesis with four accuracy points, structural error curve, analysis of mechanical error in linkages.	**(7)**
Unit 5	**Module 5:** Complex numbers- Velocity and acceleration synthesis, couple synthesis, analysis of mechanisms ,error in linkages	**(7)**
Unit 6	**Module 6**: Spatial mechanisms-Synthesis of spatial linkages, displacement analysis, matrix method of analysis, function generator for symmetric function, application of spatial mechanisms to Robotics , kinematics analysis of industrial robots, manipulators , gripper theory , Computer aided analysis of mechanisms and introduction to dynamic analysis mechanisms.	**(5)**

Text Books

1.	Arthur G Erdman and George N. Sander, "*Mechanisms Design Analysis and Synthesis Volume I, II*",4th edition, 2001.
2.	J.E. Shigley&J.J.Vickel, "*Theory of Machines and Mechanisms*", International students edition, 2001.
3.	J.E. Shigley , "*Kinematic Analysis of Mechanism*", MacGraw Hill, 1969.

Reference Books

1.	Wilson C E, Sadler J P, "Kinematics and Dynamics of Machinery*",* HRP, First Edition, 1990.
2.	Waldron K J, Kinzel G L, "*Kinematics, Dynamics and Design of Machinery",* Wiley India, First Edition, 2004.

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1		3	1	2	3		2	3	3	2	2
CO 2	3	2	2	3	2		3		3					2	3
CO 3	1	2		1		1	3	1	3	2		3	3		1
CO 4	2			2	2	3	3	1	2	2				2	
CO 5			1		1	2	3	1		3	1	3	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem -II) M. Tech. Mechanical- Design Engineering

DE 2244: Vehicle Dynamics

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Analyse suspension, steering characteristics and tyre properties
2.	Evaluate the various ride excitation sources
3.	Design vehicle systems with reference to handling and ride

	Course Contents	Hours
Unit 1	**Introduction to vehicle dynamics:** Various automobile systems and their functions, vehicle layouts, vehicle power trains, vehicle motions.	**(7)**
Unit 2	**Road loads and acceleration performance:** Drive torques and tractive efforts, rolling resistance, aerodynamic – drag, lift and side forces, total road loads, loads on grades, power limited and traction limited acceleration, gradeability	**(7)**
Unit 3	**Suspension systems:** Requirements of suspension system, types and varieties, anti pitching and anti-roll suspension geometry, Roll center analysis for solid axle and independent suspension	**(7)**
Unit 4	**Steering system and tyres:** Steering geometry and steering linkages, forces on steering system, over and under steer characteristics, tyre construction and load rating, tyre properties and influence on vehicle dynamics.	**(7)**
Unit 5	**Vehicles handling:** Steady state cornering, low and high speed cornering, under steer gradient and its effects, critical and characteristic effect, Effect of braking, tyre –road friction, brake proportioning, wheel lockup and pedal forces	**(7)**
Unit 6	**Vehicle ride**: Excitation sources – road, tyres, driveline excitations, vehicle response characteristics, stiffness, damping and suspension isolation, rigid body motions, pitch and bounce frequencies, seat vibrations and ride perception	**(5)**

Tutorials

1.	Assignment on Simplex Methods
2.	MATLAB simulation on Nonlinear Optimization
3.	MATLAB simulation on Single Variable Optimization
4.	Assignment on preparation of Topology Optimization
5.	Assignment on Constrained optimization
6	Assignment on Conjugate Direction Method

Text Books

1.	Giri N.K., " *Automotive Mechanics*", Khanna Publishers, 2002.
2.	Rao J.S and Gupta. K, "*Theory and Practice of Mechanical Vibrations*", Wiley Eastern Ltd., New Delhi -2, 2002.

Reference Books

1.	Giles J., G. Steering - "*Suspension and Tyres*", Illiffe Books Ltd., London- 1998.
2.	Ham B, Pacejka, "*Tyre and Vehicle Dynamics*",SAE Publication - 2002.
3.	Gillespie T.D, "*Fundamentals of Vehicle Dynamics*", SAE USA 1992.

Mapping of COs and POs

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CO 1	2	2	3	1		1	1	2	2	2	2	3	3	2	3
CO 2	3	2	2	3	2		3		3		1				3
CO 3	2	1		1		1		1	3	2		3	1		1
CO 4	2			1	2	2	1	1	1	2				3	
CO 5			3		2	2	2	3	1	3	1	1	3	1	1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) M. Tech. Mechanical- Design Engineering

DE 2215: Optimization Techniques (Elective – V)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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
4.	To recognize and formulate problems that arise in engineering in terms of optimization problems

	Course Contents	Hours
Unit 1	**Linear models:** Linear programming-extensions: Revised simplex method, Dual Simplex method, Bounded variables method, primal-dual relationships, duality theorems, economic 6 interpretation of dual, dual of transportation model, sensitivity analysis in LPP and transportation models, Karmarkar's interior point algorithm	**(7)**
Unit 2	**Dynamic programming:** Formulation, recursive approach, Goal programming: formulation, graphical solution, algorithm Integer programming: Formulation, Cutting plane algorithm, Branch and bound algorithm	**(7)**
Unit 3	**Nonlinear models:** Classical Optimization: Single and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers, Kuhn-Tucker Conditions	**(7)**
Unit 4	**Single-variable Optimization:** Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden-section Method, Quadratic Interpolation Method, Newton Method, Quasi-Newton Method, Secant Method Multi-variable Optimization: Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method	**(7)**
Unit 5	Conjugate Direction Method, Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon-Fletcher-Powell Method	**(7)**
Unit 6	Introduction to Constrained Optimization: Interior Penalty Function Method, Exterior Penalty function Method	**(5)**

Tutorials

1.	Assignment on Simplex Methods
2.	MATLAB simulation on Nonlinear Optimization
3.	MATLAB simulation on Single Variable Optimization
4.	Assignment on preparation of Topology Optimization
5.	Assignment on Constrained optimization
6	Assignment on Conjugate Direction Method

Text Books

1.	Operation Research-An introduction by Hamdy A Taha. Prentice Hall
2.	Introduction To Management Science, Anderson, Thomson Learning, 11Edn
3.	Operation Research Applications and Algorithms, Winston, Thomson Learning, 3 4Edn

Reference Books

1.	Introduction to Operation Research by Hiller/Lieberman. McGraw Hill.
2.	Optimization for Engine ring Design by Deb & Kalyan way.
3.	Optimization Theory and application by S. S Rao.

Useful Links

1.	http://nptel.iitm.ac.in

Mapping of COs and POs

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CO 1	2	2	2	3		2	1	1	3	2	2	3	3	3	2
CO 2	3	2	2	3			3		2		1			2	3
CO 3	2	2			1	3		1	3	2		3	2		
CO 4	2			2	2	2	3	3	2	2				3	2
CO 5			1		1	1	2	2	1	3	2	2	2	3	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) Design Engineering

DE2235: Automotive System Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) The students will be able to

1.	Apply engineering knowledge for design purpose.
2.	Estimate force applied on the components.
3.	Design components of internal combustion engine.
4.	Design Components of automobile

	Course Contents	**Hours**
Unit 1	**DESIGN OF CYLINDER AND PISTON** Choice of material for cylinder and piston, design of cylinder, piston, piston pin, piston rings.	**(8)**
Unit 2	**DESIGN OF CONNECTING ROD, CRANKSHAFT** Material for connecting rod, Connecting rod small end and big end design, shank design, design of big end cap and bolts, design of crankshaft, material for crankshaft.	**(8)**
Unit 3	**DESIGN OF VALVES AND FLYWHEEL** Design of inlet and Exhaust valves, valve springs. Materials and design of flywheel.	**(8)**
Unit 4	**DESIGN OF CHASSIS FRAME AND SUSPENSION** Study of loads, moments and stresses on Chassis frame members, design procedure of ladder type chassis frame, design procedure of leaf springs, coil springs and torsion bar springs.	**(8)**
Unit 5	**DESIGN OF FRONT AXLE AND STEERING SYSTEMS** Study of loads, moments and stresses on front axle, design procedure of front axle; Condition for true rolling motion, Ackermann steering principles, calculation of turning circle radius.	**(8)**

Text Books

1.	Giri.N.K- "Automobile Mechanics"- Khanna Publisher, New Delhi- 2012

Reference Books

1.	Julian Happian, An Introduction to Modern Vehicle Design -Smith. Edition, Publisher, SAE International, 2014.
2.	John Fenton, Handbook of Vehicle Design Analysis, Published by Society of Automotive Engineers Inc, 2016

Useful Links

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Mapping of COs and Pos

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1		2	3	1			3		3	2	
CO 2				1	2				1						2
CO 3	3	2	1			2						1	2		1
CO 4	3	2	1		1	1	2	2		3				3	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	1	2	10
Understand	4	2	10
Apply	4	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	4	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

M Tech-First Year (Sem – II) Design Engineering

DE2245: Industrial Product Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO) The students will be able to

1.	Understand the Customer Needs for a Quality Product through Market Research in product development process, concept Generation, Selection and Testing.
2.	Select the Standard Ergonomics and Industry Safety parameters in Product Design. Design a sustainable product
3.	Design Product Architecture, Prototyping and Cost and Value Engineering.
4.	Develop sustainable and commercial Product

	Course Contents	**Hours**
Unit 1	**Introduction** Challenges of product development, Identify customer needs, Successful product development, Quality and Costing aspect of product design, Market Research, Survey. (Concept of QFD- Quality Function Deployment), Product Life Cycle.	**(6)**
Unit 2	**Product Development Process and Planning** Innovation and Creativity in Product Design, Product Planning Processes, Product specifications: Process of setting specifications, functional decomposition, FAST and SOP, function structure.	**(7)**
Unit 3	**Product Architecture** Product Architecture: Implication of architecture, Establishing the architecture, Related system level design issue. Generation and evaluation of concepts – TRIZ, Decision matrix etc., Use of Computerized Data Management and `Process, Industrial Design: Overview.	**(7)**
Unit 4	**Design for Manufacturing and Assembly** Tolerance, Design of Gauges, Design for Environment, Prototyping, Engineering Materials, Concurrent Engineering, Product Costing, Value engineering, Value analysis	**(7)**
Unit 5	**Aesthetics** Aesthetic Considerations, Visual Effects of Form and Color in Product Design. **Ergonomics** Ergonomics and product design and automated systems, Anthropomorphic data and its applications in ergonomic design, Limitations of Anthropomorphic data, General approach to the Man-Machine Relationship - Workstation Design and environment (working position and posture). **Control and Displays**	**(7)**

	Configurations and sizes of various controls and displays, Design of controls in automobiles, machine tools etc., Design of instruments and controls.	
Unit 6	**Industrial Product Safety** An approach to Product Design - Elements of Design Structure for Industrial Product Design in engineering applications in manufacturing systems. Personal protective Equipment and Environment Control Prevention and specific safety measures for manufacturing and processing industry and chemical industry, Failure mode and effects analysis.	**(6)**

Text Books	
1.	"Product Design and Development", Karl T. Ulrich, Steven G. Eppinger; Irwin Tata McGraw Hill, 3rd Edition

Reference Books	
1.	"New Product Development", Tim Jones, Butterworth, Heinemann, Oxford, (1997)
2.	"Assembly Automation and Product Design", Geoffrey Boothroyd, Marcel Dekker, CRC Press.
3.	"Industrial Product Design", C W Flureshem

Useful Links	
1.	http://nptel.ac.in

Mapping of COs and Pos

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CO 1	2	1	3	1		2	3	1	2		3		3	2	1
CO 2	2	1	1	1				1	1			1	1		2
CO 3	2	2	1			2	1					1	2		1
CO 4	1	3	1		1	1		2	2	3		1	1	3	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	TA	ESE
Remember	4	2	10
Understand	4	2	10
Apply	5	4	10
Analyse	3	4	10
Evaluate	4	4	10
Create	0	4	10
TOTAL	20	20	60

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

DE 2206: Lab Practice - III

Teaching Scheme			**Examination Scheme**	
Lectures	04 Hrs/week			
Tutorials	--		ISE	25
Total Credits	02		ESE	25

Course Outcomes (CO)

At the end of the course, the students will be able to:

1.	create 1D & 2D FEA code for structural and heat transfer analysis
2.	create MATLAB code for parametric curves in CAD analysis
3.	create FEA model and analysis of real-life CAD models using commercial software package
4.	develop a model of plant (suspension system of car (quarter car model)) and PID control implementation

	Course Contents	**Hours**
1	Development of code of 1D & 2D structural analysis	2
2	Estimation of stress concentration factor of plate with central circular hole using commercial software ANSYS	2
3	Development of Bezier and Spline curve using MATLAB code	2
4	Development of MATLAB code for 2D and 3D Geometric transformation for simple geometries such as rectangle, rectangle with hole etc.	2
5	Design and development of modelling of suspension system using MATLAB and implementation of PID control on it for smooth control	2
6	FEA and Rigidity analysis of impeller in pump assembly using FEA commercial package ANSYS	2
7	FEA analysis of Pressure Vent Model using ANSYS	2
8	FEA analysis of heat transfer characteristics of pump casing	2

Text Books

1	P Girdhar – Machinery vibration analysis and predictive maintenance, Elsevier Newnes Publications
2	Collacot R.A.- Mechanical fault diagnosis and condition monitoring, London : Chapman and Hall
3	Rao, B. K. N. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford
4	A Davis – Handbook of condition monitoring, London : Chapman and Hall
5	John S Mitchell – Machinery analysis and monitoring, Penn Well Publishing, Tulsa, Okla

Reference Books

1	R G Eisenmann et-al – Machinery malfunction diagnosis and correction Pearson Publication
2	Robert Bond Randall Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications (Google eBook) John Wiley & Sons
3	Ron Barron, Engineering condition monitoring: practice, methods and applications, Longman
4	E. D. Yardley, Condition Monitoring: Engineering the Practice, Wiley

Useful Links

1.	https://onlinecourses-archive.nptel.ac.in/noc19_me27/preview
2.	https://www.iitnoise.com/webresources.htm
3.	www.plant-maintenance.com

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	2	1		1	2	3	3		3	3	3	2	
CO 2	1			3	2		3	3	2					3	3
CO 3	3	3		3		3	2		3			3	2		1
CO 4	2		2	3	1	3	3	3	3	2				3	
CO 5			3		3	1	2	1		2	1	3	2	2	3

Assessment Pattern(with revised Bloom's Taxonomy)

Knowledge Level	TA	ESE
Remember	3	2
Understand	5	5
Apply	2	5
Analyse	5	5
Evaluate	5	5
Create	5	3
TOTAL	**25**	**25**

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

DE2207: Lab Practice - IV

Teaching Scheme			Examination Scheme	
Lectures	04 Hrs/week			
Tutorials	--		ISE	25
Total Credits	03		ESE	25

Course Outcomes (CO)

At the end of the course, the students will be able to:

1.	Interface sensors (displacement, temperature, etc.) & actuators (stepper motor, DC motor, servo motors) with microcontroller with microcontroller
2.	Develop a control system and implementation on practical model
3.	Do vibration signals analysis on rotating and reciprocating system
4.	Development of product for design problem

	Course Contents	Hours
1	Interfacing of temperature sensor (thermocouple) with ARDUNIO and Raspberry PI and data collection in excel sheet using PLX-DAQ system	2
2	Interfacing of distance measurement sensor (ultrasonic) with ARDUNIO to measure a dimension of physical model	2
3	Interfacing of stepper motor and DC motor with ARDUNIO or Raspberry PI	2
4	Vibration analysis of reciprocating and rotatory machinery	2
5	Condition Monitoring	2
6	Control design and implementation of speed control of DC motor using ARDUNIO	2
7	Development of product for defined problem Team assignments are intended to pace the development process for your product. Since there is virtually no slack in this schedule the assignments must be completed on or before the scheduled due date in order to maintain the project schedule.	2
8	Assignment on Industrial product design Assignment: Customer Needs and Competitive Analysis Due Class 1. Prepare a 10-minute presentation describing the process the team used to capture the customer needs. Clearly document the customer needs determined by following the process. 2. The project Gantt Chart. Discuss the critical path and the team's management plan. 3. Develop an organized list of customer needs for your product. 4. Compile a list of existing products that may satisfy the customer base. Analyze the features of the competing products in relation to your identified customer needs.	2

Text Books

1	P Girdhar – Machinery vibration analysis and predictive maintenance, Elsevier Newnes Publications
2	Collacot R.A.- Mechanical fault diagnosis and condition monitoring, London : Chapman and Hall
3	Rao, B. K. N. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford
4	A Davis – Handbook of condition monitoring, London : Chapman and Hall
5	John S Mitchell – Machinery analysis and monitoring, Penn Well Publishing, Tulsa, Okla

Reference Books

1	R G Eisenmann et-al – Machinery malfunction diagnosis and correction Pearson Publication
2	Robert Bond Randall Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications (Google eBook) John Wiley & Sons
3	Ron Barron, Engineering condition monitoring: practice, methods and applications, Longman
4	E. D. Yardley, Condition Monitoring: Engineering the Practice, Wiley

Useful Links			
1.	https://onlinecourses-archive.nptel.ac.in/noc19_me27/preview		
2.	https://www.iitnoise.com/webresources.htm		
3.	www.plant-maintenance.com		

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	2		2	3	1	1	2	1	1	3	1	2
CO 2	3	2	2	3			3		1		1			2	3
CO 3	2	3			1	3		1		2	3	3	1		
CO 4	2			3	2	3	2	1		2		2		2	2
CO 5			1		1	3	1	1	1	1	1	1	1	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	TA	ESE
Remember	3	2
Understand	5	5
Apply	2	5
Analyse	5	5
Evaluate	5	5
Create	5	3
TOTAL	25	25

Government College of Engineering, Karad				
First Year (Sem – II) M. Tech. Mechanical-Design Engineering				
PE 2208: Seminar on Pre-dissertation Work				
Teaching Scheme			**Examination Scheme**	
Lectures	--			
Practicals	04 Hrs/week		ISE	50
Total Credits	02		ESE	50

Course Outcomes (CO)	
At the end of the course the students will be	
1.	exposed to self-learning various topics.
2.	learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3.	learn to write technical reports
	Course Contents
	Seminar – It should be based on the literature survey on any topic relevant to manufacturing engineering and management. It may be leading to selection of a suitable topic of dissertation. Each student has to prepare a write up of about 25 pages. The report typed on A4 sized sheets and bound in necessary format should be submitted after approved by the guide and endorsement of Head of Department. The student has to deliver a similar talk in front of the faculty of the department and the students. The guide based on the quality of work and preparation and understanding of the candidate shall do assessment of the seminar.
	List of Submission Seminar Report

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	TA	ESE
Remember	6	4
Understand	10	10
Apply	4	10
Analyse	10	10
Evaluate	10	10
Create	10	6
TOTAL	50	50

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

AU 2219: Constitution of India (Audit Course – II)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	--
Tutorials	-		ISE	--
Total Credits	00		ESE	--

Course Outcomes (CO)

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

1.	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2.	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3.	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4.	Discuss the passage of the Hindu Code Bill of 1956.

	Course Contents	Hours
Unit 1	**History of Making of the Indian Constitution** History Drafting Committee, (Composition & Working)	**(04)**
Unit 2	**Philosophy of the Indian Constitution** Preamble Salient Features	**(04)**
Unit 3	**Contours of Constitutional Rights & Duties** Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	**(04)**
Unit 4	**Organs of Governance** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	**(04)**
Unit 5	**Local Administration** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	**(04)**
Unit 6	**Election Commission** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women	**(04)**

Text Books

1.	The Constitution of India, 1950 (Bare Act), Government Publication.
2.	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3.	M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014
4.	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

AU2229: Pedagogy Studies (Audit Course – II)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	--
Tutorials	-		ISE	--
Total Credits	00		ESE	--

Course Outcomes (CO)

At the end of the course, the students will be able to understand

1.	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2.	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3.	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

	Course Contents	Hours
Unit 1	**Introduction and Methodology** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.	**(04)**
Unit 2	**Thematic overview** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	**(02)**
Unit 3	**Evidence on the effectiveness of pedagogical practices**, Methodology for the in-depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.	**(04)**
Unit 4	**Professional development** Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment. Barriers to learning: limited resources and large class sizes	**(04)**
Unit 5	**Research gaps and future directions** Research design, Contexts 2 Model Curriculum of Engineering & Technology PG Courses [Volume-I] [46], Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.	**(04)**

Text Books

1.	Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2.	Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3.	Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

Reference Books

	Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272– 282
	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
	Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

Useful links

	www.pratham.org/images/resource%20working%20paper%202.pdf

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

(Audit II) CM :2239 Stress Management by Yoga

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	20
Tutorials			ISE	20
Total Credits	00		ESE	60
			Duration of ESE	2 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Develop healthy mind in a healthy body thus improving social health also
2.	Improve efficiency

	Course Contents	Hours
Unit 1	• Definitions of Eight parts of yoga. (Ashtanga)	**10**
Unit 2	• Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	10
Unit 3	• Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam	10

Text Books

1.	'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2.	"Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Government College of Engineering, Karad

First Year (Sem – II) M. Tech. Mechanical- Design Engineering

(Audit II) AU2249 Personality Development through Life Enlightenment Skills.

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials			ISE	20
Total Credits	00		ESE	60
			Duration of ESE	2 Hrs 30 min

Course Outcomes (CO)

Students will be able to

1.	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve thehighest goal in life
2.	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3.	Study of Neetishatakam will help in developing versatile personality of students.

	Course Contents	**Hours**
Unit 1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	**10**
Unit 2	• Approach to day to day work and duties. • Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	10
Unit 3	• Statements of basic knowledge. • Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39Chapter18 – Verses 37,38,63	10

Text Books

1.	"Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2.	Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam,New Delhi.

Government College of Engineering, Karad

M Tech-First Year (Sem – II) Design Engineering

DE2210: Vibrations and Acoustics

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO): students will be able to -

1.	model a given vibratory system as SDOF or MDOF system, with or without damping, free and forced. Further they shall understand a self-excited systems, isolations, force transmissibility
2.	derive differential equations of motion for MDOF systems and solve using classical methods as well as numerical methods
3.	understand Application of engineering techniques, tools for machinery condition monitoring
4.	understand application of accelerometer, noise sensors and FFT analysers and its algorithm

	Course Contents	Hours
Unit 1	**Basic Introduction:** Free vibration equation of motion, influence coefficient i) stiffness coefficient (ii) flexibility coefficient generalized coordinates, coordinate couplings, Lagrange's equations matrix method Eigen values Eigen vector problems, modal analysis, forced vibrations of undamped system and modal analysis,	**(7)**
Unit 2	**Distributed-Parameter Systems,** Transverse Vibration of Strings / Derivation of the String Vibration Problem by the Extended Hamilton Principle / Bending Vibration of Beams / Free Vibration. The Differential Eigenvalue Problem / Orthogonality of Modes, Lumping / Lumped-Parameter Method Using Influence Coefficients, **Numerical methods** - (i) Rayleigh's Method, (ii) Rayleigh-Ritz Method (iii) Holzer's Method (iv) Methods of Matrix iterations (v) Transfer Matrix Method, impulse response and frequency response functions.	**(7)**
Unit 3	**Condition Monitoring:** FFT analyzer, vibration exciters, signal analysis, time domain and frequency domain analysis of signals, experimental modal analysis, machine conditioning and monitoring, fault diagnosis Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- construction, principles of operation and uses, Vibration Analyzer, Signal analysis - Analysis of Vibration Spectrum, Standards related to measurement of vibration, Machine Conditioning and Monitoring, fault diagnosis	**(7)**
Unit 4	**Vibration Instrumentations:** Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- construction, principles of operation and uses, Vibration Analyzer, Signal analysis - Analysis of Vibration Spectrum, Standards related to measurement of vibration, Machine Conditioning and Monitoring, fault diagnosis	**(7)**
Unit 5	**Noise:** Fundamentals of noise Sound concepts, Decibel Level, White noise, Weighted sound pressure level, Logarithmic addition, Subtraction and averaging, Sound intensity, Noise measurement, Sound fields, Octave band, Sound reflection, Absorption and transmission, Passby-noise, Reverberation chamber, Anechoic Chamber, Noise standards	**(7)**
Unit 6	**Nonlinear vibrations:** Sources of nonlinearity, Qualitative and Quantitative Analysis Methods, Duffings Equation, The van der Pol Oscillator / The Fundamental Perturbation Technique, Jump Phenomenon / Subharmonics and Combination Harmonics / Systems with Time-Dependent Coefficients.	**(5)**

Tutorials			
1.	Formulation / Derivation of equation of motion on practical systems such as suspension system, engine mount etc.		

2.	MATLAB simulation of single DoF system, damped, undamped, Free and Forced vibrations
3.	MATLAB simulation of Multi-DoF system using numerical methods
4.	Assignment on FFT Analyzer
5.	Assignment on Noise Analysis
6	Assignment on Nonlinear Vibrations
Text Books	
1.	Mechanical Vibrations – G.K. Grover (TMH- Sigma Series, 2008)
2.	S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.
3.	Fundamentals of Vibration, Leonard Meirovitch, McGraw Hill International Edison
Reference Books	
1.	Mechanical Vibrations, J P Den Hartog, McGraw Hill
2.	Mechanical Vibrations, Austin Church, Wiely Eastern, 2nd Edition
3.	Mechanical Vibrations, J.P. Den Hartong, Tata Mc-Graw Hill Book, 3rd Edition, 2008
4.	Vibrations and Noise for Engineers, Kewal Pujara Dhanpat Rai and Sons, 4th Edition, 2007.
Useful Links	
1.	http://nptel.iitm.ac.in

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	1		2	3	1	2		3	3	3	2	
CO 2				1			2	1	1						2
CO 3		2		3		2						1	2		1
CO 4			1	1	1	2		2	2	3				3	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	4	10
Understand	-	4	10
Apply	5	4	15
Analyse	5	4	10
Evaluate	5	4	15
Create	-	-	-
TOTAL	20	20	60

COURSE SYLLABUS

FOR

SECOND YEAR

M TECH IN DESIGN ENGINEERING

SEMESTER III

Government College of Engineering, Karad

Second Year (Sem – III) M. Tech. Mechanical- Design Engineering

DE 2301: Dissertation Phase- I

Teaching Scheme			**Examination Scheme**	
Lectures	--			
Practicals	20 Hrs/week		ISE	100
Total Credits	7		ESE	100

Course Outcomes (CO)

At the end of the course the students will be

1.	Exposed to self-learning various topics.
2.	able to learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3.	able to learn to write technical reports
4.	able to develop oral and written communication skills to present and defend their work in front of technically qualified audience.

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

SYNOPSIS APPROVAL

The Head of the Department shall appoint a committee comprising of the Guide and two experts to review and approve the synopses.

Course Contents

It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations / experimental design etc. A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work, by the evaluation
committee (*) appointed by the Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any.

(*) Note: The evaluation committee shall consist of the Guide, one senior expert faculty member and the Head of the Department or his/her representative.

The term work under this submitted by the student shall include.

1) Work diary maintained by the student and countersigned by his guide/ industrial guide.

2) The content of work diary shall reflect the efforts taken by candidates
for (a) Searching the suitable project work and literature review

(b) Visits to different factories or organizations.

(c) The brief report of feasibility studies carried to come to final conclusion.

(d) Rough / free hand sketches/ drawing.

(e) Design calculations carried by the student.

The student has to make a presentation before departmental committee comprising proposed title, literature review, research gape/ objectives, research plan and expected outcome. It is expected to complete minimum 40 % research work. Evaluation of Dissertation- I will be made as per rubrics

List of Submission

Project/Dissertation Report

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	2		2	3	1	1	2	1	1	3	1	2
CO 2	3	2	2	3			3		1		1			2	3
CO 3	2	3			1	3		1		2	3	3	1		
CO 4	2			3	2	3	2	1		2		2		2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CA	ESE
Remember	15	15
Understand	15	15
Apply	10	20
Analyse	20	10
Evaluate	20	20
Create	20	20
TOTAL	100	100

Government College of Engineering, Karad

Second Year (Sem – III) M. Tech. Mechanical-Design Engineering

DE 2302: MOOC online course

Teaching Scheme			**Examination Scheme**	
Lectures	--		-	
Practicals	-		-	
Total Credits	03			

Online courses available on digital platform like Moocs/ NPTEL/ Coursera etc., during the academic semester will be reviewed and listed by departmental faculty board before start of every semester. Suitable course for registered candidate will be recommended by seminar / dissertation guide and programme head considering skill sets and knowledge required for dissertation work of the individual candidate from the list. It shall have minimum 8-12 hrs duration, peer graded assignment and examination to award grade by online course offering agency. It will be approved by Dean (academic) case to case.

In case online course is not available, departmental committee will specially design syllabus for course under self-learning mode and guide will conduct end semester examination to award the grade.

COURSE SYLLABUS

FOR

SECOND YEAR

M TECH IN DESIGN ENGINEERING

SEMESTER IV

Government College of Engineering, Karad

Second Year (Sem – IV) M. Tech. Mechanical- Design Engineering

DE 2401: Dissertation Phase -II

Teaching Scheme			Examination Scheme	
Lectures				
Practicals	32 Hrs/week		ISE	100
Total Credits	16		ESE	200

Course Outcomes (CO)

At the end of the course the students will be able to

1.	design and develop an experimental set up/ equipment/test rig.
2.	conduct tests on existing set ups/ Equipment and draw logical conclusions from the results after analyzing them.
3.	either work in a research environment or in an industrial environment.
4.	conversant with technical report writing.
5.	present and convince their topic of study to the engineering community.

Course Contents

The candidate shall submit the detailed report as per the synopsis approved by the university, of the dissertation work in the prescribed format after approval by the Guide and endorsement by the Head of the Department. It will be assessed for term work by the evaluation committee appointed by the Head of the Department, for completion of the proposed work.

(*) Note: The evaluation committee shall consist of the Guide, one senior expert faculty member and the Head of the Department or his/her representative.

The dissertation submitted by the student on topic already approved by institute authorities on basis of initial synopsis submitted by the candidate, shall be according to following guide lines.

Format of dissertation report:

The dissertation work report shall be typed on A4 size bond paper. The total number of minimum pages shall not be less than 60. Figures, graphs, annexure etc be as per the requirement.

The report should be written in the standard format.

1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figures, Photographs/Graphs/Tables
5. Abbreviations.
6. Abstract
7. Contents.
8. Text with usual scheme of chapters.
9. Discussion of the results and conclusions

Bibliography (the source of illustrative matter be acknowledged clearly at appropriate place IEEE/ASME/Elsevier Format)

Deviation of work from approved synopsis is not permitted.

Evaluation of Dissertation- II will be made as per rubrics. Dissertation completion certificate from sponsoring industry is necessary.

Acceptance letter/ published one research paper in quality journal/ conference is essential.

List of Submission

Project/Dissertation Report

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	2		2	3	1	1	2	1	1	3	1	2
CO 2	3	2	2	3			3		1		1			2	3
CO 3	2	3			1	3		1		2	3	3	1		
CO 4	2			3	2	3	2	1		2		2		2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CA	ESE
Remember	15	30
Understand	15	30
Apply	10	40
Analyse	20	20
Evaluate	20	40
Create	20	40
TOTAL	100	200