GUJARAT TECHNOLOGICAL UNIVERSITY

English for Research Paper Writing
SUBJECT CODE: 3700001
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	17
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4	17
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	4	17
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	4	17
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	4	16
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4	16

Reference 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
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcome:

At the end of the course, the student will be 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
4. Ensure the good quality of paper at very first-time submission

GUJARAT TECHNOLOGICAL UNIVERSITY

Disaster Management
SUBJECT CODE: 3700002
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4	17
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	4	17
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	4	17
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	4	17
5.	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4	16
6	**Disaster Mitigation**	4	16

	Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.		

Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company
2. Sahni, PardeepEt.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.

Course Outcome:

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

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
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

GUJARAT TECHNOLOGICAL UNIVERSITY

RESEARCH AND IPR

M.E. SEMESTER: I

Rationale:

To the Student:

The purpose of this subject is to orient the students to the scientific methodology of research and presenting their thesis. Research constitutes primarily of literature review, giving critical comments on the literature reviewed and identifying the gap, problem formulation, modeling in either an analytical or experimental set up, validating the model and solving the problem you set for yourself.

At the end, student should be able to present and defend the solution he/she has found, in a simple and easy manner. Communicating the research outcomes, is an art wherein, you do not want to either undermine or over emphasise the content, within the short time limit given for such presentations. The balance of critical technicality and overall outcomes is the key to an effective presentation. The language, content and articulation should be such as to convey in a unified manner, the gist of your work.

To the Teacher:

It is envisaged that the teacher will discuss actual case studies to make the student understand the concepts of demonstration of examples during theory. Theory classes will be used to explain each of the concepts in Module 1 and 2. This syllabus is based on the model AICTE course prescribed in May2018.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
1	0	2	2	0	0	80	20	100

Content:

	Module 1 Starting Research	**Teaching Hrs**
1.1	**Find what is expected of you**	
	Identify specific requirements for evaluation/review and what constitutes completion of your work	
	Find where the source is available	
	Establish proper methods for finding the relevant material from the source.	
1.2	**Analyse the question**	
	Identify key areas in your field	
	Determine the nature and extension of papers that you should read	
1.3	**Identify the gaps**	

	Learn to Critique existing knowledge and how to find the gap	
1.4	**Formulate the Problem Statement**	
	Understand what should be the key aspects of your problem statement	
	Examples of effective and ineffective Titles	
1.5	**Validation**	
	Identify problem and experimental/theoretical data for comparison with your model	
	Learn how to extrapolate/scale data for validation	
	Find what is acceptable level of error and justification thereof	
	Module 2 Finding Good Literature	
2.1	**Decide which sources you will need**	
	Differentiate between journals, conferences, books, magazines and their quality	
	Understand how to establish their quality and authenticity	
2.2	**Finding Information**	
	How to conduct effective searches	
	How to find relevant papers related to your area of research	
	How to capture critical information	
2.3	**Identify main ideas in scholarly literature**	
	Understand and identify the bias, theoretical position and evidence produced	
2.4	**Write notes to organize your ideas**	
	Compare ideas and concepts from different papers	
	Module 3 Writing and Presenting your Work	
3.1	**Effective technical writing**	
	How to write Report, Paper, Developing a Research Proposal, Format of research proposal	
3.2	**Build your argument**	
	Recognise the importance of emphasizing your point	
	Distinguish between your point and the evidence available	
	Acknowledge the evidence	
3.3	**Review and finalize your work**	
	Know and follow the Process of reviewing and proof reading your work	
	Use feedback to improve your work	
3.4	**Check the logistics of your presentation**	
	Identify the key message of your presentation	
	Understand the expectations and what will be the key review points	
3.5	**Develop the structure of your presentation**	
	Understand the key components of an oral presentation	
	Know the usual structure of a good presentation	
3.6	**Prepare for delivery of your Oral presentation**	
	Rehearse and time your presentation	
	Prepare to answer questions from the audience: Fundamental concepts should be spoken from memory as reviewer will be looking for evidence of your thorough understanding.	
	Read more than the content you are presenting; keep sources ready on hand for reference;	
	Module 4 Intellectual Property	
4.1	**Patents, Designs, Trade and Copyright.,**	
	Process of Patenting and Development: Technological research innovation, patenting, development.	

4.2	**International Scenario:**	
	International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
4.3	**Patent Rights**	
	Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	
4.4	**New Developments in IPR**	
	Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies	

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel, "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Propertyin New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcome:

At the end of the course the students should be able to:

1. Conduct a quality literature review and find the research gap.
2. Identify an original and relevant problem and identify methods to find its solution
3. Validate the model
4. Present and defend the solution obtained in an effective manner in written or spoken form.
5. Follow research ethics
6. Understand IPR protection for further research and better products

GUJARAT TECHNOLOGICAL UNIVERSITY

ADVANCED MACHINE DESIGN
SUBJECT CODE: 3710801
M.E. 1st SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale:The course is intended to strengthen fundamentals of applied mechanics of solids and build understanding of design and analysis of machine components under dynamic loading. The course introduces loading design and analysis of machine components at elevated temperature. The course also includes fundamentals and application of fracture mechanics and surface failures in machine component design.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
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. 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.	09	21%
2	**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.	09	21%
3	**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.	10	24%

	Strain Based Approach to Fatigue: Strain Vs Life Curve, Mean stress effect, Strain-Life Equation, Life estimate for structural components.		
4	**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.	07	17%
5	**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.	07	17%

Reference Books:

1. Mechanical Behaviour of Materials: Engineering Methods for Deformation Fracture an Fatigue 4\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.
4. Mechanical Design of Machine Elements and Machines: A failure prevention perspective J A Collins, H Busby and G Stabb Wiley India.
5. Dislocations and Mechanical Behaviour of Materials M. N. Shetty PHI.
6. Mechanical Behaviour of Materials, 2\e T H Courney McGraw-Hill / Overseas Press India.
7. Metal Fatigue in Engineering R I Stephens, A Fatemi, R R Stephens and H O Fuchs. John-Wiley.
8. Elements of Fracture Mechanics Prashant Kumar McGraw-Hill.
9. Engineering Design Dieter, G McGraw-Hill

List of Experiments:

- Students should be assigned at least five different case studies related to design of mechanical components which covers all kind of stresses. Students must use design data books and various design standards for design and selection of the components. Students must prepare detail design reports including necessary drawings.

Course Outcome:

After learning the course the students should be able to

1. Students will be able to design mechanical components subjected to static loading.
2. Students will be able to design and analyse mechanical components subjected to dynamic loading.
3. For the design and analysis of components students will be able to incorporate effect of crack and creep.

GUJARAT TECHNOLOGICAL UNIVERSITY

COMPUTER AIDED DESIGN
SUBJECT CODE: 3710802
M.E. 1st SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: **The course is intended to provide exposure of modelling techniques for curves, surfaces and solids. It also includes topics on feature based modelling, mass property calculations and assembly modelling. Topic on CAD data formats and exchange standards is also included**

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Conventional and computer aided design processes, Product Life Cycle and Role of CAD, Applications of CAD.	02	5%
2	Principles of Computer Graphics: Introduction, graphic primitives, Plotting of analytical Curves, Coordinate systems, Half-Spaces and Homogeneous Coordinates, 2D (Translations, Rotation, Scaling and Shear) and 3D transformation (Translations, Rotation, Scaling, Shear, Orthographic and Perspective Projections), Windows to View port transformation, Clipping.	08	15%
3	Curves: Introduction to curves, parametric continuity condition, geometric continuity condition, Conics, Spline representation, Hermite Curves (Algebraic and Geometric Forms, Basis Functions, Matrix Form, Tangent Vectors, Truncating and Sub-dividing, 3-point and 4-point interpolation), Bézier Curves (Bézier basis functions, control points, truncating and subdividing, composite Bézier curve, characteristics of Bézier curve), B-Spline Curves (Uniform and Non-uniform B-Spline basis function, Quadratic and Cubic B-Spline basis function, Closed B-Spline Curve, Continuity, NURBS, Representation of conics with NURBS)	08	25%
4	Surfaces: Introduction, Implicit and explicit function of surfaces, types of surfaces, Surface Representation, Surface Analysis (Tangent, Normal, Twist, Distance Calculation, Curvature, Tangent Plane),	06	20%

	Plane Surface, Ruled Surface, Surfaces of Revolution, Tabulated Surfaces, Hermite Bi-cubic surface, Bézier Surface, Coons Surface,		
5	Solids: Introduction, Solid Representation, Properties of Solid model, Regularized Boolean set operations, Primitive instancing, Sweep representations, Boundary representations (B-rep), Constructive Solid Geometry (CSG), Comparison of representations.	05	10%
6	Advanced Topics: Feature Based Modelling: Features and primitives, Feature entities, 3D sketching, Feature representation, Creating features, Parametrics, Relations and constraints, Feature manipulations Geometric and Mass Properties: Geometric Properties, Calculate length of contours and curves, Calculate areas, Calculate centroids, Calculate inertia properties, Mass Properties, Properties Evaluation. Assembly Modelling: Differences between part and assembly modelling, Mating conditions, Bottom-up assembly modelling approach, Top-down assembly modelling approach, WCS and mate methods to assemble parts, Managing assemblies, Working with subassemblies, Assembly analysis	10	20%
7	CAD Database: Evaluation of data — exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF	03	05%

Reference Books:

1. Mastering CAD / CAM Ibrahim Zeid McGraw-Hill
2. Geometric Modelling M Mortenson Industrial Press.
3. CAD / CAM: Theory and Practice Ibrahim Zeid McGraw-Hill
4. Mathematical Elements of Computer Graphics David F Roger McGraw Hill
5. Computer Graphics: C Version Hearn and Baker Pretice Hall of India
6. Curves and Surfaces for CAGD: A Practical Guide 5/e, Gerald Farin Morgan Kaufmann
7. Computer Graphics and Geometric Modelling David Salomon Springer.
8. Computer Aided Engineering Design AnupamSaxena and Birendra Sahay Springer
9. Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development D E Whitney Oxford Press

Course Outcome:

After learning the course the students should be able to

1. Students will understand fundamentals of computer graphics and geometrical modelling.
2. Students will learn various techniques for surface and solid modelling.
3. Students will learn estimation of mass properties of model along with feature based modelling.
4. Students will learn assembly modelling and CAD data exchange.

List of Experiments:

Laboratory sessions should be conducted to include followings. Apart from conventional laboratory sessions, students should be given topics from syllabus for which they should compile literature and present the same.

1. Programming Exercises for Point, Line, and Circle Plotting
2. Programming Exercises for Curves
3. Programming Exercises for Transformations
4. Introduction to CAD Tools and Hardware
5. Surface Modelling
6. Solid Modelling
7. Programming Exercises for estimating surface and mass properties of model.
8. Assembly

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)

ADVANCED MATERIALS PROCESSING TECHNIQUES

SUBJECT CODE: 3710807

M.E. Semester -I

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Intention is to develop an understanding of the principles, capabilities, limitations and applications of commonly used advanced materials processing technologies; and in-depth knowledge of non-traditional materials processing, metal forming and micro-machining.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Overview:** Outline of advanced materials processing techniques: Non-Conventional Materials Removal Processes; Finishing Processes; Forming; Advanced Surface Engineering Processes; Joining Technologies.	2	6
2	**Advances in Non-Conventional Machining Processes:** A brief review of non-conventional machining processes, Analysis of mechanical, thermal and Electrochemical type non-traditional machining processes. Tool design for selected non-traditional machining processes. Modelling and simulation of selected processes. A comparative study of various processes.	10	22
3	**Advanced Fine Finishing Process:** Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment; Analysis and modelling of finishing mechanism; Parametric analysis; Applications.	07	15
4	**Advances in Metal Forming:** Conventional processes-High Energy Rate Forming techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming, super plastic forming, rubber forming , flow forming - Principles and process parameters- Advantages -Limitations and Applications. Overview of powder metal forming technique-Advantages-applications-Powder perform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters.	9	22
5	**Micro-Machining :** Introduction to micromachining technologies, Microelectro discharge Machining: Principles of micro-EDM, micro-EDM by Die-sinking and	06	15

	WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro-turning, micro-drilling and micro-milling, micro grinding, hybrid micro-machining method, on-line measurement by machine vision and integrated probe, Measuring Techniques in micro-machining, surface integrity and other related measurements.		
6	**Fabrication of Micro-Devices** Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication	04	10
7	**Laser Materials Processing** Fundamentals of industrial lasers. Laser materials interaction theories. Laser processing for various industries such as metals, non-metals, photovoltaic, bio-medical applications.	04	10

Reference Books:

1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, M P Groover Wiley India.
2. Manufacturing Engineering and Technology, 4/e, SeropeKalpakjian, Steven R Schmid, Pearson Education.
3. Manufacturing Processes for Engineering Materials, 5/e, SeropeKalpakjian Pearson Education
4. Modeling of Metal Forming and Machining Processes by Finite Element and Soft Computing Methods, P M Dixit, U M Dixit Springer.
5. Modern Machining Processes, Pandey, P.C., and Shan, H.S.Tata McGraw-Hill Education
6. Micromachining of Engineering Materials J.A. McGeough. CRC Press.
7. Fundamentals of Microfabrication Mark Madou CRC Press
8. Advance Method of Machining McGeough, J.A Springer.
9. Laser Processing of Materials: Fundamentals, Applications and Developments, Peter Schaaf Springer

List of Experiments:

1. A comparative study of working principle and applications of various non-conventional machining processes.
2. A comparative study of working principle and applications of various finishing processes.
3. Evaluation effects process parameters in Metal forming processes.
4. A comparative study of working principle and applications of various Micro-Machining processes, and study effects of process parameters of them.
5. Study of process parameters of Laser processing

Course Outcome:

After learning the course the students should be able to

1. Students will learn various non-conventional machining processes and will be able to select their respective parameters.
2. Students will learn fine finishing processes, micro-machining and fabrication of micro-devices.
3. Students will also learn materials processing using lesser.

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)

ADVANCED METROLOGY AND EXPERIMENTAL TECHNIQUES

SUBJECT CODE: 3710808

M.E. SEMESTER-I

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: The student will be exposed to modern inspecting techniques along with the classical metrology. Along with the metrology, design of experiments and techniques for analysis of acquired data are also included in the course

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction:** Concept of accuracy, Need for high precision measurement, Accuracy of numerical control system, Inaccuracy due to thermal aspects, Detailed surface roughness concept, Dimensioning & Dimensional chains, Surface and form metrology flatness, roughness, waviness cylindricity, Methods of improving accuracy & surface finish, Influence of forced vibration on accuracy, Dimensional wear of cutting tools and its influences on accuracy.	05	15
2	**Analysis of Experimental Data:** Causes and Types of Experimental Errors, Error Analysis on a Commonsense Basis, Uncertainty Analysis and Propagation of Uncertainty, Evaluation of Uncertainties for Complicated Data Reduction, Statistical Analysis of Experimental Data, Probability Distributions, The Gaussian or Normal Error Distribution, Comparison of Data with Normal Distribution, The Chi-Square Test of Goodness of Fit, Method of Least Squares, The Correlation Coefficient, Multivariable Regression, Standard Deviation of the Mean, *Students t*-Distribution, Graphical Analysis and Curve Fitting, Choice of Graph Formats, Causation, Correlations, and Curve-fits, General Considerations in Data Analysis	08	20
3	**Design of Experiments:** Introduction, Types of Experiments, Experiment Design Factors, Experiment Design Protocol and Examples.	04	10
4	**Laser Metrology:** Free electron laser – optical alignment, measurement of distance – interferometry, reversible counting, refractive index correction,	07	15

	reversible counting, refractive index correction, surface topography and optical component testing, beam modulation telemetry, pulse-echo techniques surface velocity measurements using speckle patterns – laser spectroscopy – modular beam spectroscopy, saturation spectroscopy, two photon spectroscopy.		
5	**Holography:** Basic principles, holographic interferometry, double exposure holographic interferometery, sandwich holograms, real time holography, time-average holographic interferometer, Character recognition	04	10
6	**Coordinate Measuring Machine:** Co-ordinate metrology, CMM configurations, hardware components, Software, Probe sensors, Displacement devices, Performance Evaluations, Dynamic errors, Thermal effects diagram, Temperature variations environment control, applications.	06	15
7	**Machine Vision and Image Processing:** Machine vision systems, Illumination, Magnification, Vision system measurement ultisensory systems. Overview of Image Processing, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms	8	15

Reference Books:

1. Experimental Methods for Engineers Holman J PMcGraw-Hill.
2. Industrial Metrology Smith GSpringer.
3. Fundamentals of Dimensional MetrologyDotson C.Cengage.
4. Metrology and MeasurementBewoor, A. K. and Kulkarni,V. A.McGraw-Hill.
5. Image Processing, Analysis, and Machine VisionSonka M, Hlavac V, and Boyle RCengage.
6. Co-ordinate Measuring Machines and SystemsBosch J A, Giddings and Lewis Dayton, Marcel Dekker.
7. Understanding and Applying Machine VisionNello, Z.Marcel Dekker.
8. Lasers – Principles, Types and Applications NambikarK New Age International Limited Publishers.
9. Lasers – Principles and ApplicationsWilson J and Hawker J F BPrentice Hall.
10. Springer Handbook of Metrology and Testing Horst Czichos, Tetsuya Saito, Leslie Smith Springer

List of Experiments:

1. Measurement of surface finish of a polished components.
2. Measurement of flatness of a surface plate.
3. Evaluation of roundness and cylindricity.
4. Statistical analysis using experimental data.
5. Analysis of Variance (ANOVA)
6. Measurement of Geometric and Form features using CMM.
7. Creation of CAD data from a physical component using CMM.
8. Generation of surface from point cloud using CMM.
9. Depth measurement using vision system (stereoscopic image).

Course Outcome:

After learning the course the students should be able to

1. Students will conceptualize fundamentals of metrology.
2. Students will be able to apply concepts of data analysis and design of experiments.
3. Students will learn advanced techniques used in metrology.

GUJARAT TECHNOLOGICAL UNIVERSITY

DESIGN FOR MANUFACTURING AND ASSEMBLY
SUBJECT CODE:3710810
SEMESTER: I

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

Rationale: To introduce the basic concepts and design guidelines of different manufacturing processes. It is also equally important to understand conceptsof design for assembly to reduce number of parts and to optimize design without compromising function. Also, current global trends and requirements of environmental design required to be addressed.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to tolerances:** Tolerances: Limits and Fits, tolerance Chains and identification of functionally important dimensions.Dimensional chain analysis-equivalent tolerances method, equivalent standard tolerance grade method,equivalent influence method. Geometric tolerances: applications, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard; surface finish, Tolerance stackup calculations; Review of relationship between attainable tolerance grades and different machining.	**7**	**18%**
2	**Form design of castings, weldments, forging and sheet metal components:** Materials choice, Influences of materials,Space factor,Size, Weight- Surface properties and production method on form design. Redesign of castings based on parting line considerations, Minimizing core requirements, redesigning cast members using Weldments-Form design aspects in Forging and sheet metal components.	**9**	**21%**
3	**Design for Assembly - Machining Considerations:** Design features to facilitate machining, Drills, Milling cutters, Keyways, Doweling procedures, Counter sunk screws, Reduction of machined area, Simplification by separation, Simplification by amalgamation,Design for machinability, Design for economy, Design for clampability, Design for accessibility, Design for assembly. Redesign For Manufacture, Design features to facilitate machining: datum features, functional and manufacturing.Component design, machining considerations, redesign for manufacture.	**9**	**21%**

4	**DFMA Tools:** Rules and methodologies used to design components for manual, automatic and flexible assembly, traditional design and manufacture Vs concurrent engineering, DFA index, poke -yoke, lean principles, six sigma concepts, DFMA as the tool for concurrent engineering, three DFMA criteria for retaining components for redesign of a product; design for manual assembly; design for automatic assembly- Computer-aided design for assembly using software.	**9**	**21%**
5	**Design for the Environment:** Introduction, Environmental objectives, Global issues,Regional and local issues, Basic DFE methods, Design guide lines, Weighted sum assessment method,Lifecycle assessment method,Techniques to reduce environmental impact, Design to minimize material usage,Design for disassembly, Design for Recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.	**8**	**19%**

Reference Books:

1. Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. A. Knight, CRC Press.
2. Assembly Automation and Product Design, G. Boothroyd, CRC Press.
3. Product Design and Development,K. T. Ulrich and S. D. Eppinger, McGraw-Hill Higher Education
4. Handbook of Product Design for Manufacturing, Bralla, James G., McGraw Hill.
5. Engineering Design - A Material Processing Approach, G E Dieter, McGraw Hill
6. Mechanical Tolerance stackup and analysis, B. R. Fischer, CRC Press.
7. Mechanical assemblies: their design, manufacture, and role in product development, D E WhitneyOxford Press.

Course Outcome:

After learning the course the students should be able to:

1. Understand the quality aspects of design for manufacture and assembly.
2. Apply varioustechniques of DFM for product design and assembly.
3. Apply the concept of designs for casting, welding, forming and assembly.
4. Identify the design factors and processes along customer desires for manufacturing.

List of Experiments:

Following is the list of representative exercises. More exercises should exercises should be developed.

1. For a given products/component, identify differences and dissimilarities between Design for Manufacturing and Design for Assembly.
2. Perform an exercise to identify features (self-locating, self-fastening, minimize orientation during assembly, retrieval, handling and insertion, symmetry) for assembly of a component.
3. Redesign: Perform exercise for a product to minimize number of parts without compromising its function.
4. Tolerance stack up analysis: Worst Case tolerance analysis, Statistical tolerance analysis
5. Geometric Dimensioning and Tolerancing inTolerance Analysis.
6. Design evaluation of the components on the basis of casting, welding and machining requirements.
7. Design and manufacture of a plug gauge.

GUJARAT TECHNOLOGICAL UNIVERSITY

Analysis and Synthesis of Mechanisms

SUBJECT CODE: 3710811

M.E. 1st SEMESTER

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

Rationale: Kinematic analysis of mechanism is must to understand motion transfer by any mechanism. This course is useful to understand motion generated by planar and spatial mechanisms. This course also helps in prepare mechanisms for desire motion.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Syllabus Contents:

Sr. No.	Topic	Teaching Hrs	Module Weightage
1	**Basic Concepts**: Definitions and assumptions; planar and spatial mechanisms; kinematic pairs;degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Reviewof graphical and analytical methods of velocity and acceleration analysis of kinematically simplemechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.	06	14%
2	**Curvature Theory**: Fixed and moving centrodes, inflection circle, Euler-Savary equation,Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwellmechanisms.	06	14%
3	**Kinematic Synthesis of planar mechanisms:** accuracy (precision) points, Chebesychev spacing,types of errors, Graphical synthesis for function generation and rigid body guidance with two,three and four accuracy points using pole method, centre and circle point curves, Analyticalsynthesis of four-bar and slider-crank mechanisms.	08	20%
4	**Synthesis of Four bar Mechanisms:** Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition,synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers,three accuracy point synthesis using complex numbers.	08	19%

5	**Coupler Curves :** Equation of coupler curve, Robert-Chebychev theorem, double points andsymmetry.	**06**	**14%**
6	**Kinematic Analysis of Spatial Mechanisms :** Denavit-Hartenberg parameters, matrix method ofanalysis of spatial mechanisms	**08**	**19%**

References:

1. R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.
2. Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition
3. Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons NewYork
4. S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York
5. A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.
6. A.G. Erdman and G.N. Sandor, "Mechanism Design – Analysis and Synthesis", (Vol. 1 and 2), Prentice Hall India, 1988.
7. A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India.
8. J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill, 1995.

List of Experiments:

Computer programming for analysis and synthesis of planar and spatial mechanisms.

Course Outcomes:

At the end of the course:

1. To develop analytical equations describing the relative position, velocity and acceleration of all moving links.
2. To select, configure, and synthesize mechanical components into complete systems.
3. Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.
4. Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
5. Analyze and animate the movement of planar and spherical four-bar linkages.
6. Students will be able to apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.
7. Finally Students will demonstrate ability to think creatively, participate in design challenges, and present logical solutions.

List of Open Source Software:

MechAnalyzer

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3710812
Semester – I
Computational Methods for Mechanical Engineers

Type of course: Core course

Prerequisite: Zeal to learn the subject

Rationale: The course intends to provide mathematical foundations to graduate students. The course should enhance their ability to develop mathematical models and solve problems using analytical and numerical methods.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Content	Total Hrs
1	**Differential Equations:** Basic Concepts: Modelling, Differential Equations, Ordinary and Partial differentiation, Order of the equation, Solution, Existence and Uniqueness of Solution, Initial Value problem, Boundary Value Problem, Linear and Non-Linear Equation. 1st Order ODE: Geometric Meaning of y'= f(x, y), Direction Fields, Euler's Method; Separable ODEs; Exact ODEs (Integrating Factors Method, Existence and Uniqueness of Solution); Linear ODEs(Homogeneous and Non-Homogeneous, Reduction to Linear problems); Orthogonal Trajectories. 2nd Order ODE: Linear Dependence and Linear Independence; Homogeneous Linear ODEs of Second Order (Principal of Superposition, Initial Value Problem, Boundary Value Problem); Homogeneous Linear ODEs with Constant Coefficients (Euler's formula and review of the circular and hyperbolic function, Exponential Solutions, Repeated Roots and Stability); Differential Operator; Modelling of Free Oscillations of Spring-Mass System; Homogeneous Linear ODEs with Non-constant Coefficient (Cauchy-Euler Equation, Existence and Uniqueness of Solutions)	08
2	**Laplace Transforms:** Laplace Transform, Linearity, First Shifting Theorem (s-Shifting); Transforms of Derivatives and Integrals, ODE; Unit Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting); Short Impulses, Dirac's Delta Function, Partial Fractions; Convolution, Integral Equations; Differentiation and Integration of Transforms, ODEs with Variable Coefficients; Systems of ODEs.	05
3	**Linear Algebra:** Matrices and Vectors: Vectors in 2-Space and 3-Space; Addition and Scalar Multiplication, Matrix Multiplication; Linear Systems of Equations and Gauss Elimination, Ill-Conditioning, Linear Independence, Rank of a Matrix, Solutions of Linear Systems: Existence	07

	and Uniqueness; Determinants and Cramer's Rule; Inverse of a Matrix, Gauss–Jordan Elimination; Solution by Iteration. Vector Spaces, Inner Product Spaces, Norms, Linear Transformations; Matrix Eigenvalues, Determining Eigenvalues-Eigenvectors and their applications; Power Method for Eigenvalues; Symmetric, Skew-Symmetric, and Orthogonal Matrices	
4	**Vector Calculus:** Vector Product; Vector and Scalar Functions and Their Fields, Vector Calculus: Derivatives; Curves, Arc Length, Curvature, Torsion; Gradient of a Scalar Field, Directional Derivative; Divergence of a Vector Field, Curl of a Vector Field. Line Integrals, Path Independence of Line Integrals; Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals; Triple Integrals, Divergence Theorem of Gauss, Further Applications of the Divergence Theorem, Stokes' Theorem.	05
5	**Fourier Analysis and PDE:** Fourier Series; Arbitrary Period, Even and Odd Functions, Half-Range Expansions; Forced Oscillations; Approximation by Trigonometric Polynomials; Sturm–Liouville Problems, Orthogonal Functions; Orthogonal Series, Generalized Fourier Series; Fourier Integral; Fourier Cosine and Sine Transforms; Fourier Transform, Discrete and Fast Fourier Transforms. Basic Concepts of PDEs; Modeling: Vibrating String, Wave Equation; Solution by Separating Variables; Use of Fourier Series; D'Alembert's Solution of the Wave Equation, Characteristics; Modelling: Heat Flow from a Body in Space, Heat Equation: Solution by Fourier Series. Steady Two-Dimensional Heat Problems	08
6*	**Numeric Analysis:** Introduction, Solution of Equations by Iteration, Interpolation, Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials, Coefficients of an Interpolating Polynomial, Inverse Interpolation; Spline Interpolation, Numeric Integration and Differentiation. Numeric Methods for: First-Order ODEs, Multistep Methods, Systems and Higher (up to second) Order ODEs, Elliptic PDEs	-
7	**Probability:** Data Representation, Average, Spread; Experiments, Outcomes, Events; Probability, Permutations and Combinations; Random Variables. Probability Distributions; Mean and Variance of a Distribution; Binomial, Poisson, and Hypergeometric Distributions; Normal Distribution	03
8	**Statistics:** Introduction, Random Sampling; Point Estimation of Parameter, Confidence Intervals; Testing Hypotheses, Decisions; Goodness of Fit, X^2 - Test, Nonparametric Tests, Regression, Linear Regression, Polynomial Regression, General Linear Regression, Nonlinear Regression, Correlation	06

Exam paper should be based on applications of above topics in Mechanical engineering rather than merely derivation of standard theory or its mathematical solution.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	50	20	-	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Advanced Engineering Mathematics, 9/e, By Erwin Kreyszig, John Wiley & Sons Inc.
2. Advanced Engineering Mathematics, 2/e, By M D Greenberg, Pearson Education
3. Numerical Methods for Engineers, S C Chapra, and R C Canale, McGraw-Hill

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To solve ordinary and partial differential equations analytically as well as numerically for Mechanical applications	35
CO-2	To apply Laplace transforms for solution of ODE	10
CO-3	To explain fundamentals and applications of linear algebra and vector calculus for Mechanical engineering problems	25
CO-4	To apply Fourier transformation to Mechanical systems	10
CO-5	To explain fundamentals of statistics and probability for nondeterministic Mechanical systems	20

List of Experiments:

Students are required to prepare computer program (using any computer software) for following topics:

1. Solution of first order differential equation using numerical techniques.
2. Solution of nonlinear equation using bisection method, false position and Newton Raphson method.
3. Interpolation by Lagrange, Newton's divided-difference and spline method.
4. Numerical integration by trapezoidal and Simpson's rules.
5. Matrix operations and power method for Eigen values and Eigen vectors.
6. Finding DFT of one dimensional signal.
7. Solving linear systems of equation using elimination and iteration methods.
8. Solution of PDE by finite difference method.
9. Fitting a straight line and quadratic curve to the given data.
10. Finding mean and variance of binomial, Poison & hyper geometric distribution.

Major Equipment: Computational facility

List of Open Source Software/learning website:

GUJARAT TECHNOLOGICAL UNIVERSITY
Advanced Stress Analysis
SUBJECT CODE: 3710909
ME 1st Semester

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

Rationale: Analysis of stresses in a component subjected to loading is an inevitable part of design process. This requires understanding and knowledge of various theories. The course aims to expose students to such theories while emphasizing on their applications under stated conditions. This includes, theories of elasticity, theory of plasticity and experimental stress analysis.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	Module Weightage
1	**Stress:** Surface forces and body forces, Cartesian components of stress on small cubic element, Stress at a point, Stress equations of equilibrium, Principal stresses, Maximum shear stress, Two dimensional state of stress, Special cases: Pure shear stress, Hydrostatic state of stress, Strain equations of transformations, Principal strain, Energy method for analysis of stress, strain and deflection , three theorem's -theorem of virtual work, theorem of least work, Castiglioni's theorem, Rayleigh Ritz method, Galekin's method,	**04**	**8%**
2	**Theory of Elasticity** Elasticity problems in two dimensions - stress strain relationship for brittle materials, ductile materials. Compatibility equations in two and three dimensions, Airy's stress function, Polar component of stress in terms of stress function free body diagram of complicated structures and stress calculations, stress functions in rectangular and cylindrical coordinate systems, evaluation of stresses in flat rectangular plates with different clamp and load conditions evaluation of the stresses in the flat and circular plate with center hole/holes using stress function.	**10**	**25%**
3	**Theory of Plasticity:** Different criterions for three dimensional stress analysis using plasticity, evaluation of stress concentration factors in different geometries using plasticity theorem, practical problems on stress analysis for plasticity, stressin the sharp groove of the shaft, stress in the L shaped bracket under cantilever load, strain rate effects on highly deformable materials and stress calculations.	**10**	**20%**

4	**Plate bending:** Bending of plate to cylindrical surface, bending of a long uniformly loaded rectangular plate, pure bending in two perpendicular directions, bending of circular plates loaded symmetrically w.r.t. center, bending of circular plates of variable thickness, circular plate with circular hole at center symmetrically loaded and load distributed along inner and outer edges.	**10**	**20%**
5	**Contact stresses:** Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area, gear contacts, contacts between cam and follower, ball bearing contacts	**8**	**15%**
6	**Experimental stress analysis:** Dimensional analysis, analysis techniques, strain gauges, types of strain gauges, materials, configuration, instrumentation, characteristics of strain gauge measurement, theory of photoelasticity, elements of polariscope, simple and circular polariscope, fringes in dark and white field, isoclinic and isochromatic fringe patterns, evaluation of stresses from these fringe patterns	******	**12%**

**** Should be covered during practical sessions (10 hrs)**

Reference Books:

1. Advanced Strength and Applied Stress Analysis, Richard G. Budynas, McGraw Hill.
2. Advanced Mechanics of Materials and Applied Elasticity, A C Ugural and A K Fenster, Pearson.
3. Theory of Elasticity, Timoshenko and Goodier, McGraw Hill.
4. Advanced Strength of Materials, Vol. 1, 2, Timoshenko, CBS.
5. Experimental Stress Analysis, J W Dally & W F Riley, Mc Graw Hill.
6. K. Ramesh, e-Book on Experimental Stress Analysis, IIT Madras, 2009.
   URL: http://apm.iitm.ac.in/smlab/kramesh/book_5.htm
7. Theory of Plates and Shells, Timoshenko McGraw Hill
8. The Mathematical Theory of Plasticity - R. Hill, Oxford University Press.

Course Outcome:

After learning the course the students should be able to:

1. Analyse stresses in components subjected to various loading.
2. Apply concepts of theory of elasticity and plasticity.
3. Analyse structures idealized as plates.
4. Analyse contact stresses in components forced against each other.
5. Learn experimental techniques for stress analysis.

List of Experiments:

1. Strain gauge Wheatstone Bridge circuit
2. To measure the strain in a loaded steel cantilever using strain gauges
3. Study of Polariscope and its components
4. Photoelastic stress measurements and fringe constant determination
5. Determination of crack depth using crack depth meter
6. Determination of SIF using Photoelasiticity
7. Problems on theory of elasticity
8. Problems on plate bending
9. Problems on contact stresses

Major Equipment:

1. Strain measurement kit
2. Digital Polariscope
3. Crack depth meter

List of Open Source Software/learning website:

1. http://www.ni.com/white-paper/3642/en/
2. http://nptel.ac.in/downloads/112106068/