

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI
(C.G.)**

Scheme of Teaching & Examination

M.E. Mechanical Engg. (Design)

II Semester

| S. No. | Board of Study | Subject Code | Subject | Periods per Week | | | Scheme of Examination | | | Total Marks | Credit L+(T+P)/2 |
|--------------|----------------|--------------|------------------------------|------------------|----------|----------|-----------------------|------------|------------|-------------|------------------|
| | | | | L | T | P | Theory / Practical | | | | |
| | | | | | | | ESE | CT | TA | | |
| 1 | Mech. Engg. | 548211 (37) | Finite Element Methods | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 2 | Mech. Engg. | 548212 (37) | CAD/CAM Application | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 3 | Mech. Engg. | 548213 (37) | Advanced Machine Tool Design | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 4 | Mech. Engg. | 548214 (37) | Advanced Mechanism | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 5 | Refer Table-II | | Elective-1 | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 6 | Mech. Engg. | 548221 (37) | Finite Element Method Lab | - | - | 3 | 75 | - | 75 | 150 | 2 |
| 7 | Mech. Engg. | 548222 (37) | CAD/CAM Lab | - | - | 3 | 75 | - | 75 | 150 | 2 |
| Total | | | | 15 | 5 | 6 | 650 | 100 | 250 | 1000 | 24 |

L- Lecture

T- Tutorial

P- Practical ,

ESE- End Semester Exam

CT- Class Test

TA- Teacher's Assessment

Table-II**ELECTIVE - II**

| S.No. | Board of Study | Subject Code | Subject |
|-------|----------------|--------------|-----------------------------------|
| 1 | Mech. Engg. | 548231 (37) | Experimental Stress Analysis |
| 2 | Mech. Engg. | 548232 (37) | Measurement System Analysis |
| 3 | Mech. Engg. | 548233 (37) | Computer Graphics & Visualization |

Note (1) – 1/4th of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a Particular academic session .

Note (2) – Choice of elective course once made for an examination cannot be changed in future examinations.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II

Subject: Finite Element Methods

Total Theory Periods: 40

Total Marks in End Semester Exam. : 100

Minimum number of class test to be conducted: 02

Branch: Mechanical Engg.

Code: 548211 (37)

Total Tutorial Periods: 12

Unit-1

Basic steps in FEM formulation, Rayleigh Ritz method, Galerkins method, Von mises stress of generalization of the finite element concepts weighted reordal and variational approaches.

Unit-2

- a) 1-D Problems, basic functions and shape functions, Convergence Criteria h & p approximations, Natural Coordinates.
- b) Application of 1-D problems –plane trusses Three dimensional trusses

Unit-3

Two-dimensional problems, Constant strain triangles, isoparametric elements, sub-parametric super parametric numerical integration and others elements, Axis symmetric solids, single variable problems.

Unit-4

Beams and frames: Finite element formulation, boundary consideration, plane frames, three dimensional frames, Eigen value and time dependent problems, plane elasticity.

Unit-5

Three-dimensional problems in stress analysis, bending of plates non-linear material problems, direct solution technique creep, Computer implementation solution technique of FEM

Text Books

- ✍✍ Introduction to finite elements in engineering by T.R.Chandrupatla & A.D.Belegundu (PHI)
- ✍✍ Introduction to the finite element method by C.S.Desai and J.F.Abdel
- ✍✍ Finite element Analysis –Theory and programming TMHBY C.S.Krishnamurthy

Reference Books

- ✍✍ Finite Element Analysis – P.Seshu PHI
- ✍✍ The finite element method in Engineering by S.S.Rao-Peragamon
- ✍✍ An Introduction to the finite Element method (MGH) by J.N.Reddy (TMH)

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: CAD/CAM Application
Total Theory Periods: 40
Total Marks in End Semester Exam. : 100
Minimum number of class test to be conducted: 02

Branch: Mechanical Engg.
Code: 548212 (37)
Total Tutorial Periods: 12

Unit-1

CAD/CAM contents and tools, History of CAD/CAM Development, Definition of CAD/CAM tools, Industrial look at CAD/CAM Hardware

Unit-2

CAD/CAM Software Introduction, Graphics Standards, Basic Definition, Software modules, Application of software in CAD/CAM.

Wire Frame models; Wire entities, Curve representation, and parametric representation of Analytical curves, parametric representation of synthetic curves. Curves manipulations, Design & Engineering applications.

Unit-3

Introduction, Surface model, Surface representation, Parametric representation of Analytic and synthetic surface Manipulations.

Solid Models, Solid Representations, Fundamentals of Solid Modeling, Half spaces, Boundary Representations, Constructive solid geometry, Sweep Representation, Analytic solid modeling

Unit-4

Geometric Transformations, Mechanical Assembly, Mass Property calculations, finite Element Modeling and Analysis.

Unit-5

Fundamentals of NC, CNC & DNC, Basics of NC Programming, NC Programming languages, Generation of Tool Path, Verification of tool path

Text Books

❧❧ Computer Aided Design and Manufacturing –M.P.Groover and E.W Zimmers, Prentice Hall, India

Reference Books

❧❧ CAD/CAM/CIM –P.Radhakrishnan and S.Subramnaiyam, New Age International

❧❧ Mathematical Elements of Computer Graphics –David. F.Rogers and J.Alan Adams, McGraw Hill.

❧❧ CAD/CAM Theory & Practice –Ibrahim Zeid –Tata Mcgraw Hill Pub.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: Advanced Machine Tool Design
Total Theory Periods: 40
Total Marks in End Semester Exam. : 100

Branch: Mechanical Engg.
Code: 548213 (37)
Total Tutorial Periods:12

Unit 1

Theory of Metal Cutting:

- 1) Cutting Tools – Types, Materials tool geometry of single point cutting tool.
- 2) Chip Formation – Deformation, yielding, shear plane and shear plane angle, velocity relationship.
- 3) Orthogonal and oblique cutting, force system during oblique cutting.
- 4) Merchant's Theory of metal cutting, calculation of stresses and strain in the chip.
- 5) Tool Wear – Factors affecting tool wear, types of tool wear, face wear, flank wear and nose wear.
- 6) Tool life, Taylor's tool life relationship.

Unit 2

Design of speed and feed gearbox:

- 1) General requirement of machine tool design, engineering process applied to machine tool.
- 2) Design of speed gear box – Aims of speed regulation, stepped and stepless drive, intermediate spindle speeds, speed diagram, structural (Ray) diagram, speeds in G.P., kinematic arrangement of gears, calculation of number of teeth, deviation diagram.
- 3) Design of speed gear box for 6, 9 and 12 speeds for lathe.
- 4) Design of feed gear box – Purpose of feed motion, types of feed drives, feed in drilling machine, milling machine, feed in lathe.
- 5) Design of longitudinal and cross feed drive for lathe machine, cutting BSW and metric threads on lathe.

Unit 3

Strength and rigidity of machine tool structures

- 1) Basic principles of design for rigidity, effect of hollow section on rigidity, methods for improving rigidity.
- 2) Design of lathe beds for bending and torsion reinforcing stiffeners in lathe beds.
- 3) Design of pillar drill columns.
- 4) Design of Radial drill columns.
- 5) Model technique in design of machine tool structures.

Unit 4

Design of machine tool slide ways:

- 1) Purpose and shapes of slide ways material of bed and guides, features of construction.
- 2) Design of guides for centre lathe, force analysis of lathe guide ways, pressure distribution on guide ways.
- 3) Design of hydrostatic guide ways.
- 4) Design of aerostatic guide ways. Design of anti-friction guide ways – ball and roller type, protecting devices for guide ways.

Unit 5

Vibration in machine tools:

- 1) Vibration measuring instruments – Introduction, Transducers – Classification, sensitivity, Dynamic response, piezo-electric transducers.
- 2) Inductive type pickups, variable reluctance pickups, capacitive pickups, vibrometer, accelerometer.
- 3) Vibration in machine tools, sources, transmission of vibration.
- 4) Machine tool chatter and dynamic instability, chatter in lathe, stability chart.

- 5) Analysis of machine tool structure for their dynamic characteristic – flexibility method, F.E.M. method.

Books Recommended:

Text Books

- ✍✍ Principles of metal cutting – G.C.Sen & A. Bhattacharya (Vol.I)
- ✍✍ Principles of machine tools- G.C.Sen & A. Bhattacharya
- ✍✍ Machine tool design – N.K.Mehta

Reference Books

- ✍✍ Mechanical Measurement – T.G.Beek & N.L. Beek (Addison Wesley Pub. co.)
- ✍✍ Measurement Techniques in mechanical engineering – R.J.Sweeney (John Wiley & Sons)
- ✍✍ Machine tool vibration– S.A.Tobias (John Wiley & Sons)

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: Advanced Mechanism
Total Theory Periods: 40
Total Marks in End Semester Exam. : 100

Branch: Mechanical Engg.
Code: 548214 (37)
Total Tutorial Periods: 12

UNIT-1

Kinematics of Mechanisms: Kinematic analysis and synthesis of Mechanism, Chebyshev spacing of precision points, Overlay Methods, Blach's Synthesis method, Freudensteins method, Design of crank lever mechanism for specified angles.

UNIT-2

Coupler Curves: Definition and equation, Roberts Law, Coupler curves from 5-bar mechanism, Design problems, Cognate of slider crank, Double points of a coupler curve.

UNIT-3

Curvature Theory: Eulers Savary equation –graphical solution, Hartmann construction, First and second Bobillier construction, Cusp points, Inflection circle for a four bar mechanism, Design of a four bar mechanism for specified angular velocities and acceleration of cranks. Cubic of stationary curvature.

UNIT-4

Analytical Design of 4- Bar Mechanism

Freudenstein's Equation, Sample design problem – three coordinated crank positions, Design for constant angular velocity ratio of cranks, Fourth order design of 4-bar mechanism to generate log function, Choice of precision points, Higher order approximation

UNIT-5

Space Mechanism –Robotics

Introduction to Robot Spatial transformation, Analysis of spatial mechanism, link and joint modelling with elementary matrices, Kinematic analysis of industrial robot. Computer aided methods for solving mathematical models of Mechanism.

Text Books

✍✍ Kinematic & Linkage Design –Allen S Hall Jr – PHI

✍✍ Advanced Mechanism and Design (Analysis & Synthesis) –Gorge N Sandal & Arthur G Erdman-PHI

Reference Books

✍✍ Mechanism & Machine Theory – J.S.Rao&R.Dukkipati, Wiley-Easten

✍✍ Analysis of Four Bar Linkage –J.A.Hornes &G.L.Nelson, John Wiley

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: Experimental Stress Analysis
Total Theory Periods: 40
Total Marks in End Semester Exam. : 100

Branch: Mechanical Engg.
Code: 548231 (37)
Total Tutorial Periods: 12

Unit-1

Basic elasticity theory, Analysis of Stress and Strain, Plane stress plane strain problems, Equation of Equilibrium, Equation of Compatibility, Boundary Condition

Unit-2

Strain Measurement Methods: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits, transducer applications, Recording instruments for static and dynamic applications.

Unit-3

Photo elasticity: Theory of photo elasticity, Analysis techniques, three dimensional photo elasticity, Reflection Palanscope and application.

Unit-4

Brittle coating methods of strain indication.

Moire Method of strain analysis.

Unit-5

Grid method of strain analysis
Computer interfacing and on-line monitoring of strain and stress fields.

Text Books

Experimental Stress Analysis by E.S.A.Dally & Rolly

Reference Books

Experimental Stress Analysis–Sadhu Singh
Experimental Stress Analysis– Adel Mubeen

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: Measurement System Analysis
Total Theory Periods: 40
Total Marks in End Semester Exam. : 100

Branch: Mechanical Engg.
Code: 548232 (37)
Total Tutorial Periods: 12

Unit-1

- Analysis of Measurement:
- Classification of Measurement, Analysis of Experimental data, Types of measurement errors, Uncertainty analysis, Propagation of uncertainty and Curve fitting

Unit-2

- Static & Dynamic Characteristics:
- Measurement system variations, static performance, characteristics, linearity, Static sensitivity, Repeatability, Hysteris threshold resolution, Redability and span, Dynamic Characteristic

Unit-3

- Direct, Indirect & Combined Measurement:
- Direct Measurements, Relationship between single and multiple measurement, Estimation of elementary errors, Calculation of uncertainty in multiple measurements, Indirect Measurements, Correlation coefficient and combined measurement, Measurement with linear equality and inequality

Unit-4

- Data analysis:
- Data acquisition and processing: Types and configuration of DAS, Signal conditioning, A/D, D/A conversions, Electro-optical devices, piezoelectric transducer, photo elastic, brittle coating and Moire Fringe stress –analysis techniques.

Unit-5

- Theory of Calibration
- Types of Calibration, Estimation of Measement Instruments in Verification, Rejects of verification and ways to reduce their number, calculation of a necessary number of standards.

Text Books

- Mechanical Measurement – Buck & Beckwith - Narosa Publishing House

Reference Books

- Measurement system – Ernest O Doebelin – Tata Mc Graw Hill 1994
- Experimental Methods for engineers, Hallisman, Tata McGraw Hill
- Engineering Experimentation –Doebelin, Tata Mcgraw Hill
- Measurement Errors and Uncertainties-Semyon G. Rabinvich-AIP Press Pub.
- Measurement & Metrology – A.K.Shawney & M.Mahajan

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: Computer Graphics & Visualization
Total Theory Periods: 40
Total Marks in End Semester Exam. : 100

Branch: Mechanical Engg.
Code : 548233 (37)
Total Tutorial Periods: 12

Unit-1

- ✍✍ Raster graphics and volume graphics. Video basics. Display devices and interactive devices; 2-D and 3-D graphics primitives.
- ✍✍ Clipping in 2-D and 3-D; Generation and projection of 3-D wire frame solid models, polygonal models. Space curves and surface models.

Unit-2

Intersection of surfaces and blending; hidden line and hidden surface elimination algorithms; Ray-surface intersection and inverse mapping algorithms. Ray tracing for photo realistic rendering. Illumination models. Shading, Transparency, Shadowing and Texture mapping; Representation of colours.

Unit-3

Visualization of experimental and simulated data. Surface construction from scattered data, 3D data arrays and 2-D cross sections. Elevation maps, topological maps, contour maps and intensity maps; fractals for visualization of complex and large data sets.

Unit-4

Algebraic stochastic and Geometric fractals. Modeling of natural forms and textures using fractals; Visualization of multi variate relations. Flow visualization and hyper streamlines; Visualization of Meteorological, cosmological, seismic, biological data for scientific decision making.

Unit-5

Animation. Modeling issues in dynamic visualization. Behavioral animation; walk through – coordinate transformation and view transformation; virtual reality interfaces. Interactive and immerse systems for Prototyping and visualization; Visualization in concurrent engineering. Interactive multimedia technology and standards for Video-Graphics -Audio integration and tele-video conferencing.

Text Books

- ✍✍ Computer Graphics By Krishnamoorthy TMH

Reference Books

- ✍✍ Computer Graphics a Program Approach By Harrington
- ✍✍ Computer Graphics By Hearn & Baker

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: Finite Element Methods Lab
Total Lab Periods: 40
Total Marks in End Semester Exam. : 75

Branch: Mechanical Engg.
Code: 548221 (37)

Experiments to be performed

1. Use and Application of Ansys and Pro-E for different types of problem related to theory of elasticity and hydrodynamic lubrication, mechanism, vibration, structure, Hydrostatic
2. Static stress analysis of wall bracket.
3. Steady state thermal analysis of circular tank and pipe assembly.
4. To perform stress analysis of 2D truss using ANSYS
5. To generate a C program to calculate stresses in a tapered shaft using FEM.
6. To generate a C program to make analysis of 2D truss using isoparametric elements in FEM.
7. to generate a C program to analyse temperature distribution in a one dimensional heat flow model
8. To use preprocessor in ANSYS to generate & mesh a model using various elements in FEM.
9. To use postprocessor in ANSYS to generate stress analysis results.
10. To analyse stress in a crane hook using ANSYS.
11. Stress analysis of leaf spring using Von Mises theory in ANSYS.
12. To perform dynamic stress analysis of connecting rod using ANSYS.

CHHATISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: M. E. II
Subject: CAD/CAM Application Lab
Total Lab Periods: 40
Total Marks in End Semester Exam. : 75

Branch: Mechanical Engg.
Code: 548222 (37)

Experiments to be performed

1. Creating Sketches in Sketching environment in CAD, Using PROE,
2. Solid Modelling-I using PROE(WF2.0).Tools like Revolve,Extrude.
3. Advance Solid ModellingI using PROE(WF2.0),Tools like Sweep,Blend,Spline Etc
4. Use of solid Modelling Edit Tools like hole,pattern,chamfer,round,fillet etc.
5. Assembly Modelling of pedestal Bearing.
6. To create drawing views of part model of a connecting rod.
7. To create a surface model of Telephone receiver/Scroll Mouse.
8. To Generate CNC Program for slot cutting in Aluminium workpiece using Master Cam on CNC Milling.
9. To Generate CNC program to drill a hole for pocketing in aluminium workpiece using Master CAM on CNC Milling
10. To simulate stress distribution in a cantilever steel beam using PRO-MECHANICA.
11. To perform part Manufacturing using PROE& MECHANICA.
12. To perform one dimensional steady state Thermal Analysis of Clutch plate.
13. To perform Stress Analysis in Dummy Axle.