

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

**Scheme of Teaching & Examination**

**M.E. Mechanical Engg. (Design)**

**I 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.	548111 (37)	Tribology	3	1	-	100	20	20	140	4
2	Mech. Engg.	548112 (37)	Mechanical Vibration	3	1	-	100	20	20	140	4
3	Mech. Engg.	548113 (37)	Advanced Dynamics of Machine	3	1	-	100	20	20	140	4
4	Mech. Engg.	548114 (37)	Theory of Elasticity & Plasticity	3	1	-	100	20	20	140	4
5	Refer Table –I		Elective-1	3	1	-	100	20	20	140	4
6	Mech. Engg.	548121 (37)	Tribology Lab	-	-	3	75	-	75	150	2
7	Mech. Engg.	548122 (37)	Mechanical Vibration Lab	-	-	3	75	-	75	150	2
<b>Total</b>				<b>15</b>	<b>5</b>	<b>6</b>	<b>650</b>	<b>100</b>	<b>250</b>	<b>1000</b>	<b>24</b>

L- Lecture  
P- Practical ,  
CT- Class Test

T- Tutorial  
ESE- End Semester Exam  
TA- Teacher's Assessment

**Table-I**

ELECTIVE I			
S.No.	Board of Study	Subject Code	Subject
1	Mech. Engg.	548131 (37)	Optimization Techniques
2	Mech. Engg.	548132 (37)	Composite Materials
3	Mech. Engg.	548133 (37)	Analysis & Design of Pressure Vessels & Components

**Note (1) –** 1/4<sup>th</sup> 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. I**

**Subject: Tribology**

**Total Theory Periods: 40**

**Total Marks in End Semester Exam. : 100**

**Minimum number of class test to be conducted: 02**

**Branch: Mechanical Engg.**

**Code: 548111 (37)**

**Total Tutorial Periods: 12**

## **Unit-1**

Introduction of Tribology, Contact of solids, Nature of Surface interaction, Types of friction, Theory of friction, Mechanism of Rolling friction, Friction instabilities. Wear and its mechanism, types of wear, Factor affecting wear, control of wear, wear test rig.

## **Unit-2**

Lubricants: Properties, selection, Regime of lubrication, Lubricant test, solid lubricant Theory of Hydrodynamic lubrication, Reynolds Equation, Infinitely Long bearing , Infinitely short bearing.

## **Unit-3**

Converging- diverging wedge, Sommerfeld Condition, Reynolds Condition, Center of pressure, Exponential film. Plane slider bearing, Raleigh step bearing.

## **Unit-4**

Hydrodynamic Journal Bearing, Pressure equation, short bearing, Sommerfeld method for infinitely long bearings, viscous friction, Petroff's Equation, cooling of bearing. Porous Bearing.

## **Unit-5**

Hydrostatic lubrication, Foot step Bearing Hydrostatic Lift.

Elastohydrodynamic Lubrication, squeeze Film lubrication, rolling contact bearing.

## **Textbooks**

- Fundamental of Tribology S.K.Basu, S.N.Sengupta-B.B.Ahuja-PHI
- Basic of lubrication Theory-A. Cameron-Wiley-Eastern Limited
- Tribology I.M.Hutching

## **Reference Books**

- Theory & Practice of lubrication for engineer by fuller D.D.-John Wiley
- Engg.Tribology, Sahoo – PHI
- Theory of Hydrodynamic lubrication by Pinkus and Sternlicht B-Mcgraw Hill
- Introduction to Tribology of bearing by-B.C.Majumdar-AH Wheeler

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

**Semester:** M. E. -I  
**Subject:** Mechanical Vibration

**Branch:** Mechanical Engg. (Mechanical Design)  
**Code:** 548112 (37)

**Total Theory Periods:** 40

**Total Tutorial Periods:** 12

**Total Marks in End Semester Exam. :** 100

**Minimum number of class test to be conducted:** 02

## **Unit-1**

Introduction –Degree of freedom, Linear and Non Linear Vibrations, Free and Forced Linear Vibration with and without damping Rayleigh's energy method, Whirling of rotating shaft, Vibration isolation, Transmissibility

## **Unit-2**

Multi Degree of Freedom System Two degree and multi degree of freedom system, Principal modes, Influence coefficient, Lagrange's Equation, Generalized coordinates and generalized forces Vibration absorber

Calculation of natural frequencies by Rayleigh, Dunkerley, Rayleigh –Ritz, Stodala and Method of matrix iteration. Calculation of higher modes.

## **Unit-3**

- a) Vibration of Continuous system Transverse vibration of a string or cable, Longitudinal vibration of bar or rod
- b) Torsional vibration of Shaft or Rod Single and Multi rotor system, Gear System, Branched System

## **Unit-4**

Non-Linear Vibration

Introduction: Phase plane representation, Method of isoclines, Perturbation method, Application of Ritz method in Non Linear Vibration, Variable spring characteristics

## **Unit-5**

Random Vibrations

Random Phenomenon, Probability distribution, Correlation function of a Random Process, Fourier Analysis

## **Text Books**

- Theory of Vibration with Application –WT Thompson CBS Publisher (Pearson Education)
- Mechanical Vibration – S.S.Rao - Pearson Education.
- Mechanical Vibration – Meronvich-TMH Pub.

## **Reference Books**

- Mechanical Vibration –Tse Morse and hinkle-PHS-Publication
- Vibration Problems in Engineering –S.Timoshenko & D.H.Young Affiliated East –West Press
- Mechanical Vibration –J.P.Denhartog McGraw Hill.

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

**Semester: M. E. I**

**Subject: Advanced Dynamics of Machine**

**Total Theory Periods: 40**

**Total Marks in End Semester Exam. : 100**

**Minimum number of class test to be conducted: 02**

**Branch: Mechanical Engg.**

**Code: 548113 (37)**

**Total Tutorial Periods: 12**

## **Unit-1**

Dynamic Force Analysis: Plane motion mechanism, D'Alemberts Principle, Analysis of a floating link, Inertia Forces, The principle of Superposition, Planar rotation about a fixed center, Shaking force and moments.

## **Unit-2**

Dynamic force Analysis: space Mechanism, Introduction, Measuring mass moment of inertia, Transformation of Inertia axes, Eulers equation of motion, Impulse and Momentum, Angular impulse and angular momentum.

## **Unit-3**

Cam Dynamics: Forces in rigid systems, Mathematical models, Response of undamped cam mechanism-analytical method, Position error, Follower response by phase plane method, jump and cross over shock, Johnson's numerical analysis, Unbalance, spring surge and Wind up

## **Unit-4**

Rotor Dynamics: Single Rotor and Multi Rotor system, balancing, Rotor dynamic consideration in design , critical speeds and unbalance response stability of rotors, vibrations of discs and blades.

## **Unit-5**

Dynamics of Feed Back Control System: Examples of automatic control system, standard input functions, Analysis of proportional-error feed back system, Harmonic input, Stability, Types of controls, Nonlinear system.

## **Text Books**

- Dynamics of Machines By Den Hartog
- Theory of Machines & Mechanism By J.E.Shigley & J.J.Vicker Jr.Mcgraw Hill

## **Reference Books**

- Rotor Dynamics By J.S.Rao
- Kinematics & Dynamics of Machine By Martin McGraw Hill

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

**Semester: M. E. I**

**Subject: Theory of Elasticity and Plasticity**

**Total Theory Periods: 40**

**Total Marks in End Semester Exam. : 100**

**Minimum number of class test to be conducted: 02**

**Branch: Mechanical Engg.**

**Code: 548114 (37)**

**Total Tutorial Periods: 12**

## **Unit-1**

Theory of Elasticity: Plane stresses and plane strain problems, Equations of equilibrium, Equations of compatibility, Boundary conditions. Stresses functions, Biharmonic Equations.

## **Unit-2**

Two Dimensional Problems in Rectangular Coordinate: Saint Venants Principle, Solution by polynomials, Bending of Cantilever and simply supported beams.

## **Unit-3**

Problems in Polar Coordinates: Stress distribution symmetrical about an axis, Bending of curved beams, Thick cylinder Rotating Solid and hollow discs, Rotating shafts and cylinder, disc of uniform strength, Shrink fit assemblies of cylinder, stress concentration due to circular hole in a plate subjected to tensile load.

## **Unit-4**

- a) Bending of Plates: Rectangular Plate, Bending of axis –symmetric plate with different end conditions.
- b) Torsion of Non Circular shafts: Saint Venants theory of rectangular shafts, Equilateral triangular shaft, Elliptical shaft, Torsion of hollow cross sections, Membrane Analogy

## **Unit-5**

Theory of Plasticity: Introduction Saint Venants theory of plastic flow, yield criteria, plastic torsion of bars of circular cross section

## **Text Books**

- Theory of Elasticity – S.P.Timoshenko &J.N.Goodier
- Theory of Elasticity - Dr.Sadhu Singh-Khanna Publishers
- Theory of Plasticity - Dr.Sadhu Singh –Khanna Publishers

## **Reference Books**

- Advanced Mechanism of Solids – L.S.Shrinath, Tata McGraw-Hill
- Advanced Strength of Materials – Den Hartog
- Introduction to Theory of plasticity for Engineers-Hoffman and Sach
- Advanced Mechanics of Materials –Dr.Kamal Kumar and Dr.R.C.Gha
- Advanced Mechanism of Materials – Seely and Smith

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

Semester: M. E. I  
Subject: Optimization Techniques  
Total Theory Periods: 40  
Total Marks in End Semester Exam. : 100  
Minimum number of class test to be conducted: 02

Branch: Mechanical Engg.  
Code: 548131 (37)  
Total Tutorial Periods: 12

## **Unit-1**

Introduction to optimization techniques: Basic Concepts, Constrained & unconstrained optimization problems. Functions of one variable, multivariable optimization with no constraints, Kuhn Tucker conditions, equality & inequality constraints. Applications of linear programming general design applications of optimization conventional Vs optimum design process, optimum design Problem formulation process.

## **Unit-2**

Non-Linear Programming: Basic Concepts of Non Linear Programming, unimodal function, elimination methods, search techniques exhaustive & dichotomous search, golden section method. Interpolation methods-Quadratic & cubic. Unconstrained minimization methods, direct search method – random search method-random search method, patterned search method-rosam brooks method, descent methods – steepest descent method

## **Unit-3**

Non linear Programming –constrained optimization techniques

Direct method-cutting plane method, gradient project method, indirect method –penalty finds method (Interior & exterior)

## **Unit-4**

Geometrical & integer programming, Introduction unconstrained minimization & constrained minimization problems. Polynomial unconstrained minimization problem Integer linear & non-linear programming.

## **Unit-5**

Stochastic Program & other topics in optimization stochastic linear & non-linear programming Introduction to optimum design with MAT LAB

## **Text Books**

- Engg.Optimization theory & practice By S.S.Rao, New Age Pub
- Optimization Concepts & application in Engg.By A.D.Belegundu, Pearson

## **Reference Books**

- Introduction to optimum design –J.S.Arora, Mcgraw Hill Pub.
- Practical Methods of Optimization –R.Fletcher, Wiley
- Optimization Theory & Practice –M.C.Joshi, Narosa Pub.

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

**Semester:** M. E. I

**Subject:** Composite Materials

**Total Theory Periods:** 40

**Total Marks in End Semester Exam. :** 100

**Minimum number of class test to be conducted:** 02

**Branch:** Mechanical Engg.

**Code:** 548132 (37)

**Total Tutorial Periods:** 12

## **Unit-1**

Classification and characterization of composite materials; fibrous, laminated and particulate composites; laminae and laminates; manufacture of laminated fibre – reinforced composite materials.

## **Unit-2**

Macromechanical behaviour of laminar; stress-strain relations, engineering constraints for orthotropic materials stress-strain relations for lamina of arbitrary orientation. Strength and stiffness of an orthotropic lamina;

## **Unit-3**

Bi-axial strength theories. Micromechanical behaviour of laminae; Rule of mixtures; Macromechanical behaviour of laminates

## **Unit-4**

Single layered configurations, symmetric laminates, and anti-symmetric laminates, known symmetric laminates; Strength of laminates; Interlaminar stresses

## **Unit-5**

Design of laminates. Buckling and vibration of laminated beams, plates and shells.

## **Text Books**

- Composite materials: Design and application by Daniel Gay-et-al.

## **Reference Books**

- Mechanics of composite materials By Richard M Christensen
- Introduction to composite materials design (Material Science & Engg.Series) By Barbero
- Composite Manufacturing Material, Product and Process Engg. By Sanjay Majumdar

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

Semester: M. E. I  
Subject: Analysis & Design of Pressure Vessels  
& Components

Branch: Mechanical Engg.  
Code: 548133 (37)

Total Theory Periods: 40  
Total Marks in End Semester Exam. : 100  
Minimum number of class test to be conducted: 02

Total Tutorial Periods: 12

## **Unit-1**

Basic principles: Elastic analysis of shells of revolution, membrane solutions, spherical and cylindrical shells, Junctions of shells of different geometry, Limit analysis, Shakedown.

## **Unit-2**

Pressure vessel branches: Radial nozzle in spherical shell, stress concentration factors due to combined loadings, design methods to reduce SCF

## **Unit-3**

Non-radial nozzles in spherical shells, Junction analysis of radial and non-radial nozzles in cylindrical shells. Pressure vessel ends: different design forms. Flanges:

## **Unit-4**

Stress analysis and design methods. Local loading and local attachments: Supports design. Creep and fatigue in thin pressure vessels and its components. Pressure vessel design codes. Thick wall design:

## **Unit-5**

Monoblock cylinders and spheres, multiplayer constructions. Pre-stressing of thick shells, shrink fit construction, wire and ribbon wound cylinders, Plastic radial expansion – autofretting. Thermal stress, creep and stress rupture; Dynamic and fatigue behaviour. Case studies: Vessels for special purposes. Computer aided design of pressure vessels

## **Text Books**

- Theory & Design of Pressure Vessel By John F Harvey

## **Reference Books**

- Pressure Vessel Design Manual By Dennis R.Moss



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

Semester: M. E. I  
Subject: Tribology Lab  
Total Lab Periods: 40  
Total Marks in End Semester Exam. : 75

Branch: Mechanical Engg.  
Code: 548121 (37)

## **List of Experiments (to be performed at least 10 experiments)**

1. To Study journal bearing apparatus.
2. To plot pressure distribution of hydrodynamic journal bearing at for a constant speed for a given SAE oil.
3. To compare the pressure distribution at constant speed for two different oil
4. To compare the pressure distribution of given SAE oil at two different speed.
5. To calculate the load carrying capacity of hydrodynamic bearing for a given oil at constant speed.
6. To find out the friction force and friction torque for hydrodynamic journal bearing
7. To study hydrostatic journal bearing.
8. To study the wear and lubrication testing machine
9. To study the wear characteristics of a lubricating oil on two different material.
10. To study the wear on a given metal for two different lubricating oil.
11. To study the change in viscosity of oil with change in temp.
12. To measure the viscosity of oil by different methods saybolt, Redwood)
13. To find flash point of lubricating oil
14. To find fire point of lubricating oil
15. To find the consistency of grease by Drop-can method

## **List of Equipments /Machine Required**

1. Journal Bearing Apparatus
2. Hydrostatic journal bearing
3. Wear and Lubrication testing machine
4. Saybolt Viscosity measuring Apparatus
5. Redwood Apparatus
6. Consistency Apparatus

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

Semester: M. E. -I  
Subject: Mechanical Vibration Lab  
Total Tutorial Periods: 40  
Total Marks in End Semester Exam. : 75

Branch: Mechanical Engg. (Design)  
Code: 548122 (37)

## List of Experiments (to be performed at least 10 experiments)

1. To determine radius of gyration of a body by using bi-filter suspension.
2. To verify Dunkerely for transverse vibration
3. Damped Torsional vibration of a body
4. To determine damping coefficient of single rotor system.
5. To find the node points and natural frequency of double (2) rotor system
6. To find the curve between frequency ratio and amplitude ratio for single degree of freedom system with spring and dashpot
7. To study the forced damped vibration of a simply supported beam at various amount of damping.
8. To calculate the whirling speed of a speed of a shaft with different end conditions and verify the results experimentally.
9. To study static and dynamic balancing machine
10. To study rithon phenomenon of Cam-Follower system.
11. To study the non-linear vibration of a pendulum system. (Simple)
12. To study the non-linear vibration of a compound pendulum system
13. To find natural frequency using accelerometer
14. To find natural frequency using vibrometer.

## List of Equipments /Machine Required

Universal Vibration Apparatus