Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

SCHEME OF TEACHING AND EXAMINATION

M. Tech. Mechanical Engineering (Design & Thermal Engineering)

Semester - II

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Board of Study</th>
<th>Sub. Code</th>
<th>SUBJECT</th>
<th>PERIOD PER WEEK</th>
<th>SCHEME OF EXAM</th>
<th>TOTAL MARKS</th>
<th>Credit</th>
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<td>1.</td>
<td>Mechanical Engg</td>
<td>579211 (37)</td>
<td>Advanced Mechanism Design</td>
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<td>579212 (37)</td>
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<td>Mechanical Engg</td>
<td>564214 (37)</td>
<td>Refrigeration &amp; Air Conditioning System Design</td>
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<td>Mechanical Engg</td>
<td>579221 (37)</td>
<td>Experiments in Thermal Engineering</td>
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<td>579222 (37)</td>
<td>Mechanical Vibration Lab</td>
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Table-II

Electives-II

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<tr>
<th>S.No.</th>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject</th>
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<tbody>
<tr>
<td>1</td>
<td>Mechanical Engg</td>
<td>564233(37)</td>
<td>Advance Gas Dynamics</td>
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<td>2</td>
<td>Mechanical Engg</td>
<td>564234(37)</td>
<td>Theory of Combustion &amp; Emission</td>
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<td>3</td>
<td>Mechanical Engg</td>
<td>579231 (37)</td>
<td>Advanced Mechanical Drives</td>
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<td>4</td>
<td>Mechanical Engg</td>
<td>548231(37)</td>
<td>Experimental Stress Analysis.</td>
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</table>

Note(1) - 1/4th of total strength of 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 can not be changed in future examinations.
Unit 1
Introduction: Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler’s Criteria, Transmission and Deviation angles, Mechanical advantage.

Unit 2
Kinematic Synthesis: Type, number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modelling in kinematic synthesis, The Dyad, Standard form, Freudenthein’s equation for three point function generation coupler curves, Robert’s law, Cognates of the slider crank chain.

Unit 3
Path Curvature Theory: Fixed and moving centrode, Inflection points and inflection circle circle, Euler’s-savary Equation, Bobillier’s and Hartsman construction.

Unit 4

Unit 5
Spatial Mechanism: Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial mechanisms.

Books Recommended:

TextBooks
1. Fundamentals of applied Kinematics D.C. Tao Addison Wesley

ReferenceBooks
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: II M.Tech (Design & Thermal Engineering)
Branch: Mechanical Engineering
Subject: Mechanical Vibration
Code: 579212 (37)
Total Theory Periods: 40
Total Tutorial Periods: 12
Total Marks in End Semester Exam.: 100
Minimum number of classes to be conducted: 02

Unit-1
Introduction – Degree of freedom, Linear and Non Linear Vibrations, Free and Forced Linear Vibration 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


Unit-3
a) Vibration of Continuous system Transverse vibration of a string or cable, Longitudinal vibration of bar rod
b) Torsional vibration of Shaft or Rod Sing leand 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, Variables pring characteristics

Unit-5
Random Vibrations
Random Phenomenon, Probability distribution, Correlation function of a Random Process, Fourier Analysis

Text Books
1. Theory of Vibration with Application– W. T. Thompson CBSPublisher (Pearson Education)

Reference Books
1. Mechanical Vibration–Tse Morse and hinkle–PHS-Publication
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: IM. Tech (Design & Thermal Engineering)  
Subject: Refrigeration & Air Conditioning System Design  
Branch: Mechanical Engineering  
Code: 564214 (37)  
Total Theory Periods: 40  
Total Tutorial Periods: 12  
Minimum marks in End Semester Exam.: 100  
Minimum number of class test to be conducted: 02

Unit - I

Cooling and Heating Load Calculations:

Solar Radiation Through Fenestration Ventilation And Infiltration
Need for fenestration in building sand effects of fenestration on air conditioning systems, concepts of Solar Heat Gain Factor (SHGF) and Shading Coefficient, calculation of shaded area of fenestrations, Need for ventilation and recommended ventilation rates, Infiltration and causes for infiltration, Estimation of heat transfer rate due to infiltration and ventilation.

Heat Transfer Through Buildings- Fabric Heat Gain/Loss
General aspects of heat transfer through buildings, one-dimensional, steady state heat transfer through homogeneous, non-homogeneous walls, opaque walls and roofs with suitable initial and boundary conditions, semi-empirical methods based on Effective Temperature Difference or Cooling Load Temperature Difference, discuss the physical significance of decrement and time lag factors and present typical tables of CLTD for walls and roof.

Unit - II
Selection of Air Conditioning Systems:
Introduction to thermal distribution systems and their functions, Selection criteria for air conditioning systems, Classification of air conditioning systems, Working principle, advantages, disadvantages and applications of all air systems, eg. Single duct, constant volume, and single/multiple zone system, single duct, dual duct, constant & variable air volume (VAV) systems, outdoor air control in all air systems, advantages/disadvantages & applications of all air systems, working principle, advantages, disadvantages and applications of all water systems, air-water systems, working principle, advantages, disadvantages and applications of unitary refrigerant based systems.

Unit - III
Transmission of Air in Air Conditioning Ducts:
Air Handling Unit (AHU) and its functions, need for transmission aspects of air in air conditioning, airflow through air conditioning ducts, Bernoulli and modified Bernoulli equations, Static, dynamic, datum and total head, Fan Total Pressure (FTP) and power input to fan, estimation of pressure loss through air conditioning ducts, Estimation of frictional pressure drop of circular and rectangular ducts using friction charts and equations, Estimation of dynamic pressure drop in various types of fittings, Static regain.

Unit - IV
Design of Air Conditioning Ducts:
Important requirements of an air conditioning duct, General rules for duct design, Classification of duct systems, Commonly used duct design methods, Principle of velocity method, Principle of equal friction method, Principle of static regain method, Performance of duct systems, System balancing and optimization, Introduction to fans and fan laws, Interaction between fan and duct system.

Ventilation for Cooling
Use of ventilated air for cooling of building sand cooling of occupants, comparison between natural ventilation and mechanical ventilation, characteristics of natural ventilation and estimation of air flow rate due to wind and stack effects, general guide lines for natural ventilation and forced ventilation using electric fans, interior air movement using interior fans, unit ventilators, whole house fan sand solar chimneys.
Unit - V
Solar Refrigeration:
Potential and scope of solar cooling, Types of solar cooling systems, solar collectors and storage systems for solar refrigeration and air-conditioning, solar operation of vapor absorption cycle, temperature concentration diagram, enthalpy concentration diagram, steady flow process with binary mixtures, Energy balance for various components of vapor absorption cycle, Analysis of absorption system using concentration chart.

Text
Books:
2. C.P. Arora, Refrigeration And Air Conditioning
3. Ahmadul Ameen, Refrigeration And Air Conditioning

References:
1. Shan K. Wang, Handbook of Air Conditioning and Refrigeration
2. Air conditioning design Handbook, Carrier Corporation, McGraw Hill,
3. ASHRAE Handbook
4. Climatological and solar data for India, Sarita Prakashan, CBRI
Unit –I
Introduction: Energy Scenario, various forms of energy, energy management and its importance, recent trends in energy conservation.
Energy Auditing and Instrumentation: Definition, methodology, analysis of past trends (plan data), closing the energy balance, laws of thermodynamics, measuring instruments, portable and online instruments. Role of Instrumentation in Energy Conservation.

Unit –II
Energy Economics: Simple payback period, time value of money, IRRNPV, life cycle costing, cost of saved energy, cost of energy generated.

Unit-III
Monitoring and Targeting: Defining monitoring and targeting, elements of monitoring and targeting, data and information, analysis techniques, energy consumption, production, cumulative sum of difference.

Unit-IV

Unit-V
Energy Efficiency in Electrical Utilities: Electrical systems, electric motors, compressed air system, HVAC and refrigeration systems, fans and blowers, pumps and pumping systems, cooling towers, lighting system, diesel generating system.

Text Books:

References:
2. Technology Menu for Efficient Energy Use: Motor Drive Systems, Prepared by National Productivity Council and Centre for Environmental Studies, Princeton University, 1993
Unit –I
Fundamental Aspects of Gas Dynamics: Introduction, Isentropic flow in a stream tube, speed of sound, Mach waves; One dimensional Isentropic Flow: Governing equations, stagnation conditions, critical conditions, maximum discharge velocity, isentropic relations.

Unit –II

Unit –III
Prandtl Meyer flow, reflection and interaction of expansion waves, flow over bodies involving shock and expansion waves; Variable Area Flow: Equations for variable area flow, operating characteristics of nozzles convergent-divergent supersonic diffuses.

Unit –IV
Adiabatic Flow in a Duct with Friction : Flow in a constant area duct, friction factor variations, the Fanno line; Flow with Heat addition or removal: One-dimensional flow in a constant are a duct neglecting viscosity, variable area flow with heat addition, one-dimensional constant area flow with both heat exchanger and friction, Generalized Quasi-One-Dimensional Flow: Governing equations and influence coefficients; solution procedure for generalized flow with and without sonic point;.

Unit –V
Two-Dimensional Compressible Flow: Governing equations, vorticity considerations, the velocity potential, linearized solutions, linearized subsonic flow, linearized supersonic flow, methods of characteristics.

Text Books:

References:
Unit –I
Generation and nature of pollutants from various combustion sources, classification of pollutants, primary and secondary pollutants, Stationary and mobile sources, Significance of natural and artificial pollutants, Properties of major air pollutants

UNIT- II
Effect of combustion pollution on man, material and vegetation, Study of air pollution disasters of world, acid rains, ozone holes.

UNIT- III
Thermo chemistry of pollutant formation, stochiometry, chemical thermodynamics, kinetics. Formation of CO, Sox, Nox, Thermodynamics of combustion, combustion of coal, oil, gas, naturalgas, LPG.

UNIT-IV

UNIT- V
Control technology for particulate, for gaseous pollutants, for Sox, for Nox, for odour pollution, Meteorology and dispersion of pollutants, instruments for pollutant measurement and monitoring, Legislation and emission standards.

Text Books:
3. K.V.S.G MurliKrishna,Air PollutionandControl,KaushalandCo,Kakinada

References:
1. IntroductiontoCombustionPhenomenaby Taylor&Francis
2. Pollutioncontrolinprocess IndustriesbySP Mahajan,TataMcGrawHill
4. InternalCombustionEngine Fundamentals byFergusonJhonWiley
Unit 1

Belt Drives: Belt vibrations, additional stress due to vibration, modern development in toothed belt, fatigue, synchronization, slip due to wear.

Dynamics & vibration of Arms of Pulleys by three Approaches (1) Equal sharing of load zone (2) Equilibrium of rim (3) FEM Approach.

Unit 2

Gears: Detailed dynamics of gear tooth, spur tooth vibrations, Estimation of additional stress under vibration. Fatigue intooth due to contact stress. Exact estimation of gear mesh frequencies in signature analysis.

Unit 3

Gear Boxes: Kinematic Analysis of complex gear trains, Force Analysis including gyroscopic effects, Vibration Analysis of Gearboxes, Lubrication Methods, Contamination of Lubrication Oils, wear debris analysis.

Unit 4


6 PIV Drives: Concept, Need, Classification & Types. Detailed kinematics & dynamics of 4/5 important drives.

Unit 5

Couplings: Stress analysis of coupling bolts during one rotation, Rubbing of coupling pins & its effect on signature, Analysis due to misalignment, Degree of shock absorption due to flexible elements in flexible couplings.

Text Books
3. Handbook of shaft Alignment

Reference Books
**Chhattisgarh Swami Vivekanand Technical University, Bhilai**

**Semester:** II M.Tech (Design & Thermal Engineering)  
**Branch:** Mechanical Engineering  
**Subject:** Experimental Stress Analysis (Elective-II)  
**Total Theory Periods:** 40  
**Total Marks in End Semester Exam.:** 100  
**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**

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

**Reference Books**

1. Experimental Stress Analysis–SadhuSingh  
2. Experimental Stress Analysis–AdelMubeen
Lab Experiments in the field of:-

1. Fluid Mechanics
2. Heat Transfer
3. Refrigeration & Air Conditioning

Results be presented after due uncertainty analysis.
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