# C:\Users\admin\Desktop\logo.pngIPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme & Syllabus

# Civil Engineering Department

(U.G. NBA Accredited up to June2023)

## Bachelor of Technology (B.Tech.)

**Honors Certification in Computer Aided Structural Engineering**

(To be offered to students of Civil Engineering Department)

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| **S.No.** | **Semester** | **Subject Code** | **Subject Name** | **Contact Hours per week** | **Total Credits** |
| **L** | **T** | **P** |
| 1 | V | HOCE-SE-501 | Theory of Vibration | 3 | 1 | - | 4 |
| 2 | VI | HOCE-SE-601 | Computer Aided Earthquake Resistant Design of Structures | 3 | 1 | - | 4 |
| 3 | VII | HOCE-SE-701 | Computer Aided Structural Health Monitoring  | 3 | 1 | - | 4 |
| 4 | VIII | HOCE-SE-801 | Disaster Management and Preparedness | 3 | - | - | 3 |
| **Total** | **12** | **3** | **-** | **15** |
| **Total Academic Engagement and Credits** | **15** | **15** |

\* L:Lecture,T:Tutorial,P:Practical

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| **HOCE-SE-501** | **Theory of Vibration** | **3L:2T:0P(5hrs.)** | **4credits** |

**Course Objective**:

Theory of vibration is important for understanding the mathematics of vibrations for the successful operation of drill strings, large engines, seismic operations and aspects of oil and gas.

## Course Contents: (62hrs.)

### Module1: ( 12hrs)

**Introduction:** Types of Vibrations, S.H.M., Principle of Superposition applied to S.H.M., Energy Method-Rayleigh Method.

### Module2: ( 12 hrs)

**Undamped Free Vibrations:** Single degree of freedom systems. Undamped free vibration, natural frequency of free vibration, Spring and Mass elements, effect of mass of spring, Compound Pendulum.

**Module 3: (14 hrs)**

**Damped Free Vibrations:** Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping. Vibration Isolation.

### Module4: ( 16 hrs)

**Systems with Two Degrees of Freedom:** Introduction, principle modes and normal modes of vibration, coordinate coupling, generalized and principal co-ordinates. Free vibrations in terms of initial conditions. Geared systems. Forced oscillations-Harmonic excitations. Applications: vehicle suspension, dynamic vibration absorber and dynamics of reciprocating engines. Continuous systems: introduction, vibration of string, longitudinal vibration of rods, torsional vibration of rods, Euler’s equation for beams.

### Module5: ( 08 hrs)

**Numerical Methods for Multi-Degree Freedom Systems:** Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerleys’s Equation.

## Course Outcomes

CO1 Understand the basics of vibration.

CO2 Understand the concept of undamped free vibration.

CO3 Understand the concept of damped free vibration.

CO4 Understand the systems having two degree of freedom system.

CO5 Implement the numerical methods for the multi-degree freedom system.

## List of Text/ Reference Books

## Thomas W.T., Theory of Vibration with Applications, Dahleh Pearson Education 5th Edition, 2008

## Singh V.P., Mechanical Vibrations, Dhanpat Rai & Company Pvt. Ltd 2016

## Graham Kelly S, Schaum’s outline of Mechanical Vibrations, Schaum’s Outlines, 1996

## Rao S. S., Mechanical Vibrations, Pearson, 2016

## Hartog D., Mechanical Vibrations, McGraw Hill, 1956

## Meirovitch L., Elements of Vibration Analysis, McGraw Hill, 1975

## Balachandran B., Magrab E. B., Fundamentals of Vibrations, Cengage Engineering New Delhi, 2009

## Ramamurti V., Mechanical Vibration Practice and Noise Control, Narosa, New Delhi, 2012

## Paz M., Structural Dynamics-Theory & Computations, 2nd Edition, CBS Publishers, 2010

## Clough and Penzien, Dynamics of Structures, 5th Edition, McGraw Hill Book Co., 1975

## Chopra A.K., Dynamics of Structures, 5th Edition, Pearson, 2017

## Venkatachalam R., Mechanical Vibrations, 1st Edition, PHI Learning, 2014

## Biggs J.N., Introduction to Structural Dynamics, McGraw Hill Book Co., 1964

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| **HOCE-SE-601** | **Computer Aided Earthquake Resistant Design of Structures** | **3L:1T:0P (4hrs.)** | **4credits** |

**Course Objective**:

Earthquake resistant design consists of an evaluation of the earthquake excitation and the structure response to this excitation at a particular site in order to provide a structural system that will not collapse, that may prevent loss of life and will limit economic loss during an earthquake.

## Course Contents: (46 hrs.)

### Module1: ( 08hrs)

**Earthquake ground motion engineering and seismology:** Introduction, Theory of Plate Tectonics, Seismic Waves, Earthquake size, local site effects, seismic zoning map of India. Evaluation and Seismic Design Parameters, Types of Earthquakes, Earthquake Ground Motion, Characteristics, Response Spectra and Design Spectrum.

### Module2: ( 10 hrs)

**Design Forces for Buildings:** Equivalent Static Method; Mode superposition technique; Dynamic Inelastic Time History Analysis; Advantages and Disadvantages of these methods, Model Analysis using response spectrum analysis.

**Module 3: (10hrs)**

**Ductility considerations in earthquake resistant design of RC Building:** Impact of ductility; Requirements for ductility; Assessment of ductility-Member/Element Ductility, Structural Ductility; Factor affecting ductility; Ductility factors; Ductility considerations as per IS13920.

### Module 4: ( 10 hrs)

**Basics of Earthquake Resistant Design of RC Buildings:** Step by step procedure for seismic analysis of RC buildings, Preliminary data, loading data, analysis of subframes, load combinations, design of subframes (maximum 4 storeys)

### Module5: ( 08 hrs)

**Computer Aided Earthquake Resistant Design of RC Building:** Implementation of basics of earthquake resistant design concept in STADD Pro or STRAP or any other design software based Computer Aided Design.

## Course Outcomes

CO1 Understand the basics of seismology and the seismic design parameters.

CO2 Analysis of the RC building using response spectrum.

CO3 Study the basic elements for considering the ductile detailing in RC buildings.

CO4 Implement the numerical stepwise procedure of earthquake resistant design to RC buildings.

CO5 Understanding to design software by implementing the basics of structural design.

## List of Text/ Reference Books

## Agarwal P. and Shrikhande M., Earthquake Resistant Design of Structures, Prentice-Hall of India, 2006.

## Paulay T. and Preistley M.J.N., Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, 1991.

## Duggal S.K., Earthquake Resistant Design of Structures, Oxford University Press

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| **HOCE-SE-701** | **Disaster Management and Preparedness** | **3L:2T:0P (5 hrs.)** | **4credits** |

**Course Objective**:

Disaster Management and Preparedness refers to measures taken to prepare for and reduce the effects of disasters. That is, to predict, prevent and mitigate their impact on vulnerable populations, and respond to their consequences.

## Course Contents: (42hrs.)

### Module1: ( 10hrs)

**Introduction:** Hazard, Risk, Vulnerability, Disaster, Dimensions and Scope of Disaster Management, Disaster Management Cycle, Natural Disasters: Hydrological and Geological; Man-Made Disasters: CBRN-Chemical, Biological, Radiological, Nuclear, Fire

### Module2: ( 10 hrs)

**Disaster Preparedness and Plan:** Concept and Significance, Measures, Institutional Mechanism for Disaster Preparedness, Policies and Programs. Disaster Preparedness Plan: Concept and Significance, Community Based Plan, Prediction, Early Warnings and Safety Measurements

**Module 3: (08 hrs)**

**Role of Different Organizations:** Role of Information, Education, Communication and Training; Role of Government, International and NGO Bodies; Role of IT in Disaster Preparedness; Role of Geographers on Disaster Management.

### Module4: ( 08 hrs)

**Disaster Response:** Essential components of Disaster Response, Disaster Response Plan, Resource Management-Financial, Medical, Equipment, Communication, Human, Transportation, Food and Essential Commodity. Disaster Response Plan-Communication, Participation, Activation of Emergency Preparedness Plan, Search, Rescue, Evacuation, Logistic Management

### Module5: ( 06 hrs)

**Psychological Response and Management:** Trauma, stress, rumor, panic, relief and recovery, medical health response to different disasters

## Course Outcomes

CO1 Understand the basics of disaster management.

CO2 Understand the plans proposed for disaster preparedness.

CO3 Understand the involvement of organizations in the disaster management.

CO4 Understand the concept of disaster response.

CO5 Understand the psychological response and its management.

## List of Text/ Reference Books

## Gupta H.K., Disaster Management, Universities Press

## Dhawan N.G. and Khan A.S., Disaster Management and Preparedness, CBS Publishers & Distributors Pvt. Ltd.

## Srivastava A.K., Textbook of Disaster Management, Scientific Publishers

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| **HOCE-SE-801** | Computer Aided Structural Health Monitoring | **3L:T:0P (3hrs.)** | **3 credits** |

**Course Objective**:

## Sense to identify the health of existing structures by mean of general visualization techniques and associated advanced methods.

## Course Contents: (40hrs.)

### Module1: ( 08 hrs)

## Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance

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### Module2: ( 08 hrs)

## Structural Health Monitoring: Concept, Various Measures, Structural Safety in Alteration Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

### Module3: ( 08 hrs)

## Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

### Module4: ( 08 hrs)

## Structure Behaviour (I): Study of behaviour of Beams under flexure, shear, Study of behaviour of under reinforced and over reinforced beams using software and its model validation.

### Module5: ( 08 hrs)

## Structure Behaviour (II): Analysis and Design of structures with different configurations using computer softwares and preparation of detailed drawings with model validation.

**Course Outcomes:**

## CO1: Diagnose the distress in the structure by understanding the causes and factors

## CO2: Assess the health of structure using static field methods.

## CO3: Assess the health of structure using dynamic field tests.

## CO4: Identification of behaviour of structure using FEM Based software.

## CO5: Development of soft skill structural design concept using STAAD Pro or any other relevant software.

**TEXT BOOKS**

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.

2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.

**REFERENCES**

1. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.

2. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.