JSPM University Pune

Faculty of Science and Technology

NEP aligned Syllabus

for

PhD in School of Civil and Environmental Sciences

(Effective from AY: 2023-24)

Semester - I

Level – 8

JSPM University Pune

PhD "Air Pollution and Control"

Course Type: PCC	Course Title: Air Pollution and Control	
Course Code: 230GCED01	**Teaching Scheme: 3Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03 Hours/Week** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:
Basic concepts of sciences, mathematics

Course Objectives:

01 Impart the knowledge and understanding of outdoor and indoor air pollution, its impact and existing legislation and regulation.

02 Make aware about the meteorology, measurement techniques, emission inventory and modeling aspects.

03 Provide the scientific and technical background of state of the art air pollution control technologies.

Course Outcomes: On completion of the course, learner will be able to

CO1: Recall air pollution, legislation and regulations.
CO2: Evaluate air pollutant concentrations as a function of meteorology.
CO3: Interpret sampling results with prescribed standards.
CO4: Assess emission inventory and air quality models.
CO5: Compare the air pollution control equipments.
CO6: Infer indoor air pollution and its mitigation.

Course Contents

Unit I	Air Pollution, Legislations and Regulations	(8 Hrs)

Air Pollution: Layers of atmosphere, Atmospheric temperature and altitude, Composition of air, Definition of air pollution, Air pollution episodes and accidents (Donora Pennsylvania 1948, Great London Smog 1952, Bhopal Gas Tragedy 1984), Classification of air pollutants (Based on sources, origin and state of matter), Criteria and hazardous air pollutants, Greenhouse gases, Sources of air pollution, Scales (micro, meso, macro), Processes and fates (Advection, convention, Diffusion, dispersion), Impact on human health and its valuation, Ozone depletion, Acid rain, Global warming, Climate change, Estimation of Carbon footprints (Numerical Included). Legislations and regulations: A case study (Air Act 1981, The Air Rules 1982, Central Motor Vehicles Act 1988, Environmental Protection Act 1986, National Environment Tribunal Act 1995,

National Green Tribunal Act 2010, Draft Notice for e-Vehicles in National Capital Region 2022), Major Government Initiatives for managing ambient air quality (NAMP-National Air Quality Program, AQI-Air Quality Index (Significance, calculation method adopted by CPCB), NCAP-National Clean Air Program)

Unit II	Meteorological Aspects	(8 Hrs)

Meteorology, Meteorological parameters and measuring instruments, Wind rose diagram, Environmental lapse rate (ELR) and adiabatic lapse rate (ALR), Inversion and its types, Atmospheric stability, Pasquill-Gifford classification, Plume behaviour, Horizontal and vertical dispersion coefficients, mixing height, Determination of mixing height using radio-soundings and remote sounding system, Stack height determination (Numerical included), CPCB recommendations, Plume rise estimation using Brigg's formula (Numerical included), Gaussian dispersion equation for point source; assumptions, advantages and limitations (Numerical included).

Unit III	**Ambient Air Sampling, Analysis and Standards**	**(8 Hrs)**

Ambient Air sampling and Analysis: Air pollution survey, basis and statistical considerations of sampling sites, Conversion of µg/m3 to ppm, devices and methods used for sampling of particulates and gaseous air pollutants. Use of aerosol spectrometer and sensors, Stack emission monitoring for particulate and gaseous air pollutants, isokinetic sampling, Air Quality and Emission Standards: Components of air quality standards (Indicator, averaging time, form, level), National Ambient Air Quality Standards (NAAQS) 2009 and Emission standards in India, WHO air quality guidelines 2021, Interpretation of sampling results with case study.

Unit IV	**Emission Inventory and Air Quality Modeling**	**(7 Hrs)**

Emission inventory: Definition, Role in air quality management, Utilization, Development approach (Bottom-up, Top-down), Basic equation of emission estimation, Types (Annual average, seasonal, forecasted and gridded), Emission inventory framework developed by CPCB, Air Quality Modeling: Introduction, Basic components, Importance, classification (Based on time period, pollutant type, coordinate system, level of sophistication), Types of air quality models (Physical, statistical, deterministic), AERMOD model USEPA (Assumptions, strengths and limitations).

Unit V	**Control of Air Pollution**	**(7 Hrs)**

Natural self-cleansing properties (Dispersion, gravitational settling, absorption, rainout, adsorption), Objectives, Control by process modification, change of raw materials, fuels, process equipment and process operation, Control of particulates from stationary sources: Removal Mechanism, collection efficiency, control equipment as Settling chamber, inertial separators, cyclone, fabric filter and electro Static precipitator. Scrubbers, Factors affecting selection of device (Numerical included). Control of gaseous pollutants from stationary sources: Absorption, adsorption, incineration/ combustion, carbon sequestration for CO_2, Control of emissions from mobile sources: Emission sources, Control of emissions from each source.

Unit VI	**Indoor Air Pollution**	**(7 Hrs)**

Causes, sources, health impacts, factors affecting indoor air quality, sick building syndrome, General aspects of exposure assessment, Sampling design, Active and Passive samplers, monitoring of ventilation rates, Mitigating technologies: Source control, Improved ventilation, air cleaning, Types of air cleaners, Air cleaning technologies, Practical considerations using portable and in-duct air cleaners, Use of plants for control, Radon removal technique, Sources and remedial measures for odour control.

Learning Resources

Text Books: (Maximum 2)

1. Air Pollution: Its origin and control, 3rd Edition, Kenneth Wark, Cecil F. Warner, Wayne T. Davis, Addison-Wesley Longman. 1998.
2. Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.),CRC Press, 2010

Reference Books:

01 Air Pollution, M. N. Rao, H. V. N. Rao, McGraw Hill, 2004.
02 Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015.
03 Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., Academic Press, 2005.
04 Methods of Air Sampling and Analysis, Lodge, J.P. (Ed.), CRC Press, 1988.

JSPM University Pune

PhD "RISK & SAFEY MANAGEMENT IN CONSTRUCTION"

Course Type: PCC	**Course Title: RISK & SAFEY MANAGEMENT IN CONSTRUCTION**	
Course Code: 230GCED02	**Teaching Scheme:3Hrs/Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

1.
2.

Course Objectives:

- A broad knowledge of risk concepts, principles and terminology;
- A good comprehension of how major project risks are identified and assessed
- An understanding of specific risk analysis methodologies and the ability to apply them in practice
- An understanding of capital project program and pre-construction strategies and approaches
- An up-to-date knowledge of risk management best practices in the AEC industry

Course Outcomes: On completion of the course, learner will be able to

CO1: An ability to showcase nuances of theoretical knowledge, skill quotient, comprehension of process and application to professional practice.

CO2: An ability to critically review, assess and evaluate Risk based process, options, potentials and constraints in real time projects.

CO3: An ability to interpret case-based studies, engage in interdisciplinary research, publications and prepare technical documents and reports

CO4: An ability to integrate technical expertise, strategic decision making and legal mechanism to provide innovative and practical solutions.

CO5: An ability to contribute to holistic development solutions that are context specific and in the larger global perspective.

CO6: Understand the Investigation of Accidents.

Course Contents

Unit I	**Safety management function**	**(8Hrs)**

Safety management function, line versus staff authority, safety responsibility and accountability in construction industry. Safety Policy - Safety Committee - Responsibility of Management with respect to Safety - Safety Officers Duties & Responsibilities - Safety Targets - Safety Objectives - Safety Standards - Safety Practices and Performances.

Unit II	**Safety Hazards**	**(8Hrs)**

Safety and its importance in construction industry, hazards in construction projects, causes of accidents, cost of an accident.

Unit III	**Safety Modification Rating**	**(8Hrs)**

Experience Modification Rating, Workers insurance, general safety programs in construction industry, construction safety problems. Environment Discipline towards Safety: Introduction to Environment Discipline, Importance of Discipline, General Principles of discipline, Essentials of discipline and outward Signs.		
Unit IV	**Forecasting Methods**	**(7Hrs)**
Case based reasoning, case indexing, retrieval, accident prevention and forecasting using CBR method. Hazard and Risk: Causes of Hazard & Risk, Identification of Hazard & Risk, Evaluation & Control.		
Unit V	**Safety analysis**	**(7Hrs)**
Systems safety analysis, faulty tree analysis, failure modes and effects analysis in construction industry. Accident: Industrial Accidents, Classification of Accidents, Need for the Analysis of Accidents, Accidents Reports		
Unit VI	**Safety Reports**	**(7Hrs)**
Methods Adopted for Reducing Accidents, Investigation of Accidents, Safety Slogans and Sources for Information on Hazard Evaluation, Risk and Risk Analysis.		

Learning Resources
Text Books: (Maximum 2) 1. Construction safety manual published by National Safety Commission of India. 2. Safety Management in Construction Industry – A manual for project managers. NICMAR Mumbai.
Reference Books: 1. Construction Safety Handbook – Davies V.S.Thomasin K, Thomas Telford, London. 2. ISI for safety in Construction – Bureau of Indian Standrads. 3. “Safety management” –Girimaldi and Simonds, AITBS, New Delhi.

JSPM University Pune **PhD “Remote Sensing and Geographic Information System”**		
Course Type: PCC	**Course Title: Remote Sensing and GIS**	
Course Code:230GCED03	**Teaching Scheme: 03 Hours/Week**	**Examination Scheme:**
Credits: 03	**Lecture (L): 03** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:
The basic knowledge of Engineering Mathematic, Physics, Surveying, Engineering Geology

Course Objectives:

01 To comprehend fundamentals and principles of RS and GIS techniques.
02 To enhance students' capacity to interpret images and extract information of earth surface from multi-resolution imagery at multi-scale level.
03 To develop skills of Image processing and GIS
04 To utilize RS and GIS techniques in Engineering Geology and civil engineering.
05 To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
06 To learn buffering and layer analysis for civil engineering applications

Course Outcomes: On completion of the course, learner will be able to
CO1: Articulate fundamentals and principles of RS techniques.
CO 2: Demonstrate the knowledge of remote sensing and sensor characteristics.
CO 3: Distinguish working of various spaces-based positioning systems.
CO 4: Analyze the RS data and image processing to utilize in civil engineering
CO 5: Explain fundamentals and applications of RS and GIS
CO 6: Acquire skills of data processing and its applications using GIS

Course Contents

Unit I	**Remote Sensing**	**(8Hrs)**

Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering/town planning.

Unit II	**Remote Sensing Satellites and Sensor Characteristics**	**(8Hrs)**

Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image interpretation, image interpretation.

Unit III	**Geographical coordinate system**	**(8Hrs)**

An angular unit of measure, a prime meridian, and a datum (based on a spheroid), difference between UTM and geographic coordinate system

Unit IV	**Image Processing and Analysis**	**(7Hrs)**

Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised & unsupervised). Digital elevation model (DEM) and its derivatives, triangular irregular network model (TIN) and other models & their applications.

Unit V	**Fundamentals of GIS**	**(7Hrs)**

Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, thematic layers and layer combinations, difference between drafting software's and GIS, fundamentals of cartography and map design, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.

Unit VI	**GIS Data and Applications**	**(7Hrs)**

GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies: demarcation of dam catchment and command area, application in reservoir sediment analysis, application in land measurement work for land record department, applications of land use and land cover pattern, application in urban planning, applications in irrigation planning and scheduling, application in smart cities planning and development.

Learning Resources

Text Books: (Maximum 2)

Principals of Remote Sensing, Panda B C, Viva Books Private Limited

Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad.

Reference Books:

01 Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography
University of South Carolina Columbia

02 Remote Sensing and Image Interpretation, Lillesand Thomas M. and Kiefer Ralph, John
Villey

03 Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing

JSPM University Pune

F.Y. Ph.D. "Structural Engineering"

Course Type: PCC	**Course Title: Engineering Seismology**	
Course Code: 230GCED04	**Teaching Scheme: 03hours/week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

1.
2.

Course Objective:

- To have an overall concept dynamic characteristics of structures and their behaviour under different types of dynamic load.

Course Outcomes: At the end of course, Students will be able to

CO1: To understand the Propagation of earthquake
CO2: To know the Seismicity of earth
CO3: To understand the Magnitude of earthquake.
CO4: To remember the Earthquake recording methods.
CO5: To understand the Processing & analysis of earthquake.
CO6: To explain the prediction of earthquake.

Course Contents

Unit I	**Propagation of earthquake**	**(8 Hrs)**
Propagation of earthquake Waves, Body & surface waves, laws of reflection, refraction and attenuation, travel times curves, internal structure of earth		
Unit II	**Seismicity of earth**	**(8 Hrs)**
Seismicity of earth, major earthquakes in the world, important Indian Earthquakes, earthquake catalogs, plate tectonics, causes of earthquakes		
Unit III	**Magnitude**	**(7 Hrs)**
Magnitude, energy, intensity, acceleration, return period, frequency, Ground motion characteristics		
Unit IV	**Earthquake recording**	**(8 Hrs)**
Earthquake recording instruments, seismographs, different modes of recording analogue, digital, micro-earthquake, tele-seismic, local, strong motion		
Unit V	**Processing & analysis**	**(7 Hrs)**
Processing, analysis and interpretation of earthquake data, determination of magnitude, epicentral distance, focal depth, seismic hazard and risk, seismic zoning		
Unit VI	**Prediction**	**(7 Hrs)**
Introduction to prediction of seismic event, Design earthquake parameters		

Learning Resources
Reference Books: 1. Richter,C.F. Elementary Seismology, Eurasia Publishing House (Pvt) LTD, New Delhi 2. Agrawal, P.N., Engineering Seismology, Oxford& IBH Publishing Co. Pvt. Ltd, New Delhi 3. Aki,K and Richard, P.G. Quantitative seismology, Theory and Methods, Vol. I and II, W.H. Freeman & Co. 4. Lee, W.H.K and Stewart, SW. Principles and applications of micro-earthquake networks, 1981, Academic Press Inc.
MOOC / NPTEL Courses: 1. NPTEL Course "*Engineering Seismology*", Prof. Deepankar Choudhury, IIT Bombay Link of the Course: https://nptel.ac.in/ **Additional Web Resources**: https://www.youtube.com/watch?v=2GDJOjRBIPI

JSPM University Pune **F.Y. Ph.D. "Structural Engineering"**		
Course Type: PCC	**Course Title: Theory of Vibration**	
Course Code: 230GCED05	**Teaching Scheme: 03 hours/week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**
Prerequisite Courses, if any: 1. 2.		
Course Objective: • To have an overall concept dynamic characteristics of structures and their behaviour under different types of dynamic load.		
Course Outcomes: At the end of course, Students will be able to CO1: To understand the objectives of dynamic analysis CO2: To know the dynamics of damped and undamped SDOF system CO3: To understand the dynamics of MDOF system. CO4: To remember the Practical Vibration Analysis of 2 DOF system. CO5: To understand the Partial Differential Equation of Motion. CO6: To explain the Response Spectrum method.		
Course Contents		
Unit I	**Introduction to Dynamics**	**(7 Hrs)**
Introduction to Dynamics, Objectives of dynamic analysis, Types of prescribed dynamic loading, Characteristics of a dynamic problem, Methods of discretization: Lumped mass Procedure/Consistent mass procedure, Single Degree Freedom Systems, D'Alembert's Principle.		
Unit II	**SDOF System**	**(8 Hrs)**

Response of Un-damped/Damped free vibrations of SDOF systems, Un-damped/Damped vibrations of SDOF systems subjected to Harmonic loading, Displacement Meters, Resonant Response, and Vibration Isolation.		
Unit III	**MDOF System**	**(8 Hrs)**
Multi Degree of Freedom Systems Formulation of Equations of Motion, Evaluation of Lumped Mass Matrix, Analysis of Frequency matrix and mode shape matrices using determinantal equation, Orthogonality Conditions, Mode super position procedure for damped forced vibrations, Time History Analysis.		
Unit IV	**Practical Vibration Analysis**	**(7 Hrs)**
Practical Vibration Analysis Stodola Method, Holtzer Method - Fundamental mode only, Lagrange's Equations of Motion, Application to simple un-damped problems of 2-DOF systems.		
Unit V	**Frequency of Continuous System**	**(8 Hrs)**
Distributed Parameter Systems Partial Differential Equation of Motion - Beam Flexure (Elementary case) - Undamped free vibrations (Elementary case)		
Unit VI	**Dynamic Analysis**	**(7 Hrs)**
Analysis of dynamic response, Earthquake Resistant Design: Brief exposure to relevant IS Codes of Practice, Method of construction of Response Spectra.		

Learning Resources

Reference Books:

1. Rao, S.S., Mechanical Vibrations,5ed.,Addison-Wesley Publishing Co., Reading, Massachusetts, 2010.

2. Paz, M., Structural Dynamics, 4ed, CBS Publishers & Distributors, New Delhi, 1997

3. Chopra, A. K., Dynamics of Structures, 4ed.,Prentice-Hall of India Pvt. Ltd., New Delhi, 2011.

4. Craig, R.R., Structural Dynamics An Introduction to Computer Methods, John Wiley &Sons, New York, 1983.

MOOC / NPTEL Courses:

2. NPTEL Course "*Structural Dynamics*", Prof. Pradipta Banerji, IIT Bombay

Link of the Course:
https://nptel.ac.in/courses/105101006

Additional Web Resources:

JSPM University Pune

Faculty of Interdisciplinary Studies

School of Doctoral Studies and Research

Course Type: PCC	**Course Title: Advanced Concrete for Structural Applications**	
Course Code: 230GCED06	**Teaching Scheme: 03 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 marks**

Prerequisite Courses, if any:

1. Concrete Technology

Course Objectives:

- To provide an in-depth understanding of types of cementitious material, admixtures and special concrete
- To cultivate knowledge regarding durability and micro structure of concrete

Course Outcomes: On completion of the course, learner will be able to

CO1: To understand the fundamentals of cement production and supplementary cementitious materials
CO2: To explore the role of admixtures in enhancing the properties of concrete
CO3: To examine the properties and applications of special concretes
CO4: To understand the challenges and advancements in the field of concrete 3D printing
CO5: To analyze the factors affecting the durability of concrete structures
CO6: To investigate the microscopic structure of concrete and its influence on macroscopic properties

Course Contents

Unit I	**Cement and Supplementary cementitious materials**	**(8 Hrs)**

Cement production, cement composition, cement classification, cement chemistry, supplementary cementitious materials: Specifications of fly ash, silica fume and GGBFS for use in concrete, reaction mechanism

Unit II	**Admixture**	**(8 Hrs)**

Chemical admixtures: Water reducers, Air entraining agents, understanding concrete rheology, Viscosity modifying agents, Shrinkage reducing admixtures
Mineral Admixtures: Introduction, classification and pozzolanic activity, GGBFS, Metakaolin and LC3, Agricultural ashes - characterization techniques and Life Cycle Assessment

Unit III	**Special Concretes**	**(7 Hrs)**

High strength concrete and ultra high-performance concrete, Self-compacting concrete, Fibre reinforced concrete, Mass concreting and lightweight concrete, High density concrete, Ready Mix Concrete

Unit IV	**3D printing of Concrete**	**(7 Hrs)**

Conventional construction vs 3D Printing, evolution of the technology, Construction 3D printing techniques, Steps in Additive Manufacturing of concrete, Rheology of fresh concrete, testing rheological behaviour, Quality control of hardened 3D-printed concrete		
Unit V	**Durability of concrete**	**(7 Hrs)**
Creep, Shrinkage, Sulphate attack, Chloride ingress, carbonation, freezing and thawing Corrosion of steel reinforcement in concrete, Experiments on durability index: Rapid chloride permeability test, Oxygen permeability test, and Water absorption test, Sorptivity test. Life cycle assessment of concrete		
Unit VI	**Microstructure of Concrete**	**(8 Hrs)**
Micro structural characterization of cementitious materials, Scanning Electron Microscopy, Applications of EDX with SEM, TEM		

Learning Resources

Text Books:

1. P.K. Mehta & P.J.M. Monterio, "*Concrete and its Microstructure*", ICI, Third Edition
2. A.M. Neville, "*Properties of Concrete*", Pearson Education, Fifth Edition

Reference Books:

1. V. S Ramachandran and James J.Beaudoin, "*Handbook of Analytical Techniques in Concrete Science and Technology*", Elsevier, First Edition
2. A.M. Neville & J.J. Brooks, "*Concrete Technology*", Addison- Wesley, Second Edition
3. ACI Manual of Concrete practice.
4. Jay G. Sanjayan, Ali Nazari, Behzad Nematollahi, "*3D Concrete Printing Technology: Construction and Building Applications*", Butterworth- Heinemann (Elsevier), First Edition 2019.

MOOC / NPTEL Courses:

1. NPTEL Course "*Advanced Topics in the Science and Technology*", Prof. Ravindra Gettu, IIT Madras.
   Link of the Course: https://archive.nptel.ac.in/courses/105/106/105106187/

2. NPTEL Course "*Admixtures and Special Concretes*", Prof. Manu Santhanam, IIT Madras.
   Link of the Course:https://onlinecourses.nptel.ac.in/noc23_ce61/preview

JSPM University Pune

Faculty of Interdisciplinary Studies

School of Doctoral Studies and Research

Course Type: PCC	**Course Title: Smart Materials**	
Course Code: **230GMED03**	**Teaching Scheme: 03 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

1. Metallurgy & Material Science
2. Chemistry
3. Physics

Course Objectives:

1. To introduce the materials characterization techniques to the students
2. Help the students to understand the instrumentation aspects
3. To provide a detailed understanding of data interpretation
4. To provide hands-on experience of the characterization techniques

Course Outcomes: On completion of the course, learner will be able to

CO1: Distinguish various engineering materials as well as their fabrication techniques, testing and characterization methods.
CO2: To achieve knowledge in various spectroscopic techniques in the study of structure and properties of materials.
CO3: Able to understand the surface structure and atomic surfaces at nano scale.
CO4: To analyze the phase information and solve crystal structures materials.
CO5: To understand the dimensional properties of materials and its behavior as a function of time or temperature.
CO6: To understand the measurement techniques required to characterize mechanical properties of the materials.

Course Contents

Unit I	**Introduction to Smart Materials**	**(8 Hrs)**

Classification of Engineering Materials: Metals, Ceramics, Polymers, Composites, Shape memory alloys, and their Types; Material Structure, Bonding, Crystals: Lattice, Points, Directions, Planes – Miller Indices, Reciprocal Lattice, Grain Boundaries; Iron-Carbon Phase Diagram: Cast Iron and Steels; Phase Diagrams of Non-Ferrous Metals & Alloys.

Unit II	**Atomic and Molecular Spectroscopy**	**(8 Hrs)**

Atomic Absorption, Fluorescence and Emission Spectroscopy, UV-Visible Spectroscopy, Infrared Spectroscopy, Raman Spectroscopy, Energy Dispersive X-ray Spectroscopy, X-ray Photoelectron Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Mass Spectrometry.

Unit III	**Imaging Microscopies and Image Analysis**	**(7 Hrs)**

Optical Microscopy, Scanning Electron Microscopy, Scanning Probe Microscopy, Image Analysis.		
Unit IV	**X-ray and Electron Diffraction**	**(7 Hrs)**
Properties of X-Rays, Review of Crystal Systems and Miller Indices, Stereographic Projections, The Reciprocal Lattice, Laué Equations, Diffraction Methods, Scattered Intensities, Phase Identification, Small angle scattering.		
Unit V	**Thermal and Thermomechanical Techniques**	**(7 Hrs)**
Differential Scanning Calorimetry and Differential Thermal Analysis, Thermogravimetric Analysis, Dynamic Mechanical Analysis and Thermomechanical Analysis.		
Unit VI	**Mechanical Analysis**	**(8 Hrs)**
Mechanical analysis: tensile, compressive, impact, flexural, hardness, fracture toughness, creep and fatigue testing. Dynamic mechanical analysis (DMA), Rheometer, In-situ testing and inspection of components, Non-destructive testing - Radiography, Ultrasonic, Acoustic emission.		

Learning Resources

Text Books:

1. Y. Leng, Materials Characterisation: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia), 2008.
2. S. Zhang, Lin Li, A. Kumar, Materials Characterisation Techniques, CRC press, 2008

Reference Books:

1. D. A. Skoog, F. J. Holler and S. R. Crouch, “Principles of Instrumental Analysis”, Sixth Edition, Cengage Learning, New Delhi, 2007.
2. B. D. Cullity and S. R. Stock, “Elements of X-ray Diffraction”, Third Edition, Prentice Hall Inc., New Jersey, 2001.
3. K.P. Menard, “Dynamic Mechanical Analysis; A Practical Introduction”, CRC Press, Boca Raton, 1999.
4. S. Zhang, L. Li and A. Kumar, “Materials Characterization Techniques”, CRC Press, Boca Raton, 2008.
5. Y. Leng, “Materials Characterization: Introduction to Microscopic and Spectroscopic Methods”, Second Edition, Wiley-VCH, 2013.
6. R.M. Silverstein, Spectrometric identification of organic compounds, 7th ed., John Wiley and Sons, 2007.
7. C.R. Brundle, C.A. Evans, S. Wilson, Encyclopedia of Materials Characterisation, Butterworth Heineman, 1992

MOOC / NPTEL Courses:

1. Techniques of Material Characterization by Prof. Shibayan Roy, IIT Kharagpur. https://nptel.ac.in/courses/113105101

JSPM University Pune

Faculty of Interdisciplinary Studies

School of Doctoral Studies and Research

Course Type: PCC	**Course Title: Structural Health Monitoring**	
Course Code: 230GCED07	**Teaching Scheme: 03 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

Course Objectives:

- To impart the fundamentals of structural dynamic
- To analyze the need and challenges of Structural Health Monitoring (SHM).

Course Outcomes: On completion of the course, learner will be able to

At the end of the course, the students will be able to:
CO1 Understand the fundamentals of Structural Health Monitoring (SHM).
CO2 Describe various methods of damage detection
CO3 Describe various non-destructive methods
CO4 Apply the Structural Health Monitoring technique for buildings
CO5 Apply the Structural Health Monitoring techniques for bridges
CO6 Explain the role of AI in Structural Health Monitoring

Course Contents

Unit I	**Introduction to Structural Health Monitoring**	**(7 Hrs)**
Factors affecting the health of structures, SHM scheme, various steps in SHM, damage diagnostic methods, challenges in SHM, Experimental modal analysis, operational modal analysis and combined methods		
Unit II	**Methods of Damage Detection**	**(8 Hrs)**
Vibration Control & SHM Damage Diagnostic methods based on vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method.		
Unit III	**Non-Destructive Testing**	**(8 Hrs)**
Concrete strength assessment –Rebound hammer test – Ultrasonic pulse velocity tests, penetration resistance, pullout tests, core sampling and testing, chemical tests – carbonation, chloride, content and corrosion problem		
Unit IV	**Health Monitoring Systems of Building Structures**	**(8 Hrs)**
Numerical modeling– Use of sensors – Data acquisition techniques – Data Processing – Diagnostic techniques – Wireless sensor network – Rehabilitation techniques.		
Unit V	**Health Monitoring of Bridges**	**(7 Hrs)**

Measurement of Parameters, Sensors/Transducers technologies, Measurement & Health monitoring Techniques: Vibration signal analysis, Strain gauge-based Instrumentation, Destructive & Non-destructive testing, Load Test, etc		
Unit VI	**Artificial Intelligence in SHM**	**(7 Hrs)**
Damage detection, Objectives; Important role in SHM; Advantages of AI in SHM; Difference between conventional AI and computational AI; Role of AI in SHM; Artificial Neural Network (ANN) in SHM.		

Learning Resources

Text Books:

5. Modi, Poonam I. Patel, Chirag N., "*Repair and Rehabilitation of concrete Structures*" PHI Publication, First Edition 2016.
6. J. Bhattacharjee, "*Concrete Structures Repair, Rehabilitation and Rettrofitting*", CBS Publication, First Edition 2019.
7. Charles R Farrar, and Keith Worden, "*Structural Health Monitoring: A Machine Learning Perspective*", John Wiley & Sons, First edition.
8. Nagayama, T. and Spencer Jr, B.F., *Structural health monitoring using smart sensors*, NSEL Report Series, 2007.

Reference Books:

1. Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes "*Structural Health Monitoring*", John Wiley and Sons, 2006.
2. Douglas E Adams, "*Health Monitoring of Structural Materials and Components Methods with Applications*", John Wiley and Sons, 2007.
3. J.P. Ou, H. Liand Z.D. Duan, "*Structural Health Monitoring and Intelligent Infrastructure*", Taylor and Francis Group, London, UK, 2006.
4. Victor Giurglutiu, "*Structural Health Monitoring with Wafer Active Sensors*", Academic Press Inc, 2007.

MOOC / NPTEL Courses:

3. NPTEL Course "*Structural health monitoring*" S. Chandrasekaran, IIT Madras.

Link of the Course: https://archive.nptel.ac.in/courses/114/106/114106046/

JSPM University Pune

Faculty of Science and Technology

School of Doctoral Studies and Research

Course Type: PCC	**Course Title: River Restoration and Bioremediation**	
Course Code: **230GCED08**	**Teaching Scheme: 03** **Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

Course Objectives:

1. Apply knowledge in assessing river ecosystems, considering fish, invertebrates, and plant communities, along with physical and chemical parameters.
2. Apply knowledge in assessing river ecosystems, considering fish, invertebrates, and plant communities, along with physical and chemical parameters.
3. Apply knowledge in assessing river ecosystems, considering fish, invertebrates, and plant communities, along with physical and chemical parameters.
4. Apply knowledge in assessing river ecosystems, considering fish, invertebrates, and plant communities, along with physical and chemical parameters.

Course Outcomes:

1. Apply knowledge in assessing river ecosystems, considering fish, invertebrates, and plant communities, along with physical and chemical parameters.
2. Identify and comprehend pollution sources, habitat destruction, and alterations caused by urbanization, channelization, and damming in river environments.
3. Apply microbial and phytoremediation techniques for effective river restoration, utilizing the role of bacteria, fungi, and plants in biodegradation and pollution control.
4. Assess successful river restoration projects through national and international case studies, and understand the importance of adaptive management in learning from failures and improving restoration processes.
5. Explore innovative tools such as genetic and molecular applications, as well as remote sensing in bioremediation, adapting restoration strategies to climate change.
6. Understand the challenges and opportunities in climate change and river restoration, preparing for future directions in sustainable river ecosystem management.

Course Contents

Unit I	**Introduction to River Ecosystems and Restoration Principles**	**(8 Hrs)**
Overview of River Ecosystems, Characteristics of river ecosystems, Importance of rivers in ecological balance, Introduction to restoration ecology, Historical context and key concepts, Ecological and socio-economic considerations in river restoration.		
Unit II	**Ecological Assessment of River Systems**	**(8 Hrs)**

Biotic and Abiotic Components, Fish, invertebrates, and plant communities, Physical and chemical parameters, Assessment Techniques, Biological monitoring, Water quality assessment, Sediment analysis		
Unit III	**Anthropogenic Impacts on River Environments**	**(7 Hrs)**
Pollution Sources, Point and non-point source pollution, Industrial and agricultural impacts, Habitat Destruction and Alteration, Urbanization effects, Channelization and damming.		
Unit IV	**Bioremediation Techniques in River Restoration**	**(7 Hrs)**
Microbial Remediation, Role of bacteria and fungi, Biodegradation of pollutants Phytoremediation, Plants as bio accumulators, Constructed wetlands		
Unit V	**Case Studies and Best Practices**	**(7 Hrs)**
Successful River Restoration Projects, National and international case studies, Evaluation of restoration outcomes, Adaptive Management, Learning from failures, Iterative process in restoration		
Unit VI	**Emerging Technologies and Future Directions**	**(8 Hrs)**
Innovative Technologies, Genetic and molecular tools in bioremediation, Remote sensing applications, Climate Change and River Restoration, Adapting restoration strategies to climate change, Future challenges and opportunities		

Learning Resources
Text Books: 1. Ronald L. Crawford and Don L. Crawford, “Bioremediation: Principles and Applications" 2nd Edition, 2005. 2. LC De Waal, “Rehabilitation of Rivers - Principles & Implementation: Principles and Implementation”, 1998.
MOOC / NPTEL Courses: **4.**

Faculty of Science and Technology

School of Civil Engineering and Environmental Sciences

PhD (Civil Engineering)

Course Type: PCC	Course Title: INDUSTRIAL WASTE WATER TREATMENT	
Course Code: **230GCED09**	**Teaching Scheme: 3 hrs. /Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

1. Environmental Engineering

Course Objectives:

The course aims at

- Distinguish between the quality of domestic and industrial water requirements and Wastewater quantity generation
- Understand the industrial process, water utilization and waste water generation
- Impart knowledge on selection of treatment methods for industrial wastewater
- Acquire the knowledge on operational problems of common effluent treatment plants.
- Gain knowledge on different techniques and approaches for minimizing the generation and application of Physio-chemical and biological treatment methods for recovery, reuse and disposal of industrial wastewater.

Course Outcomes: On completion of the course, learner will be able to

CO1: Define and reason about fundamental concepts of waste water treatment

CO2: Learn a firm foundation and knowledge of mathematics, science and engineering Principles and the ability to apply the knowledge.

CO3: Design and conduct experiments and the ability to analysis the data, interpret results and draw conclusions.

CO4: Design a component, system or process to meet desired needs and imposed constraints.

CO5: Think logically, critically and creatively.

CO6: Use appropriate modern techniques skills and tools including computer applications, necessary for engineering practice

Course Contents

Unit I	Introduction	(8Hrs)
Sources of Pollution - Physical, Chemical, Organic & Biological properties of Industrial Wastes - Difference between industrial & municipal waste waters - Effects of industrial effluents on sewers and Natural water Bodies.		
Unit II	**INDUSTRIAL WASTEWATER TREATMENT**	**(8 Hrs)**
Pre & Primary Treatment - Equalization, Proportioning, Neutralization, Oil separation by Floating-Waste Reduction-Volume Reduction-Strength Reduction.		
Unit III	**ADVANCED WASTEWATER TREATMENT**	**(8 Hrs)**

Waste Treatment Methods - Nitrification and De-nitrification-Phosphorous removal -Heavy metal removal - Membrane Separation Process - Air Stripping and Absorption Processes - Special Treatment Methods - Disposal of Treated Waste Water.		
Unit IV	**OVERVIEW OF INDUSTRIAL WASTEWATER**	**(8 Hrs)**
Characteristics and Composition of waste water and Manufacturing Processes of Industries like Sugar, Characteristics and Composition of Industries like Food processing Industries, Steel, and Petroleum Refineries.		
Unit V	**Composition of Industries and Domestic sewage**	**(8 Hrs)**
Characteristics and Composition of Industries like Textiles, Tanneries, Atomic Energy Plants and other Mineral Processing Industries, Joint Treatment of Raw Industries waste water and Domestic Sewage, Common Effluent Treatment Plants(CETP) , Location, Design, Operation and Maintenance Problems , Economical aspects.		
Unit VI	**CASE STUDIES**	**(5 Hrs)**
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries , Pulp and paper, metal finishing, Oil Refining, Pharmaceuticals, Sugar and Distilleries		

Learning Resources

Text Books: (Maximum 2)

1. Metcalf & Eddy, “Wastewater engineering Treatment disposal reuse”, Tata McGraw Hill
2. Eckenfelder, W.W., “Industrial Water Pollution Control”, McGraw-Hill

Reference Books:

1. "Industrial wastewater management, treatment & disposal, Water Environment"
2. Lawrance K.Wang, Yung Tse Hung, Howard H.Lo and Constantine Yapijakis “handlook of Industrial and Hazardous waste Treatment”, Second Edition, 2004.

MOOC / NPTEL Courses:

1. NPTEL “Industrial Wastewater Treatment”, Prof. Alok Sinha, Prof. S K Gupta | Indian Institute of Technology (Indian School of Mines), Dhanbad, India.

   Link of the Course: https://archive.nptel.ac.in/courses/105/105/105105178/

Additional Web Resources:

JSPM University Pune

Faculty of Science and Technology

School of Doctoral Studies and Research

Course Type: PCC	**Course Title: Sustainable Construction and Smart Project Management**	
Course Code: 230GCED10	**Teaching Scheme: 03 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

Course Objectives:

5. Acquire knowledge of built environment features, emphasizing sustainable practices, materials, and energy-saving techniques.
6. Grasp infrastructure project costing fundamentals, enhance skills in monitoring and control, and understand the dynamic interplay between cost, cash flow, and working capital management.
7. Equip with quantitative methods crucial for effective project management, facilitating analysis and resolution of real-life project challenges.
8. Gain contractor-perspective insights into project risks, mastering mitigation strategies for both pre-bid and execution stages.

Course Outcomes: On completion of the course, learner will be able to understand about sustainable construction practices and project management.

7. Apply best practices in construction, material selection, and energy conservation for environmentally friendly infrastructure.
8. Demonstrate proficiency in costing, monitoring, and control principles in infrastructure projects, supported by case studies.
9. Demonstrate the use of quantitative methods to analyze and solve real-life project management problems, enhancing decision-making abilities.
10. Identify, assess, and mitigate risks in infrastructure projects during pre-bid and execution stages for project success.
11. Utilize value engineering techniques to enhance product leadership and cost-effectiveness in alignment with industry and government emphasis on cost improvement.
12. Understand and apply environmental geotechnology principles, incorporating geosynthetic materials for sustainable waste planning and disposal in engineered landfills.

Course Contents

Unit I	**Green Construction for Sustainable Built Environment**	**(8 Hrs)**

To learn about various features/parameters of our built environment focusing largely on buildings that affect our environment and what are the best practices in terms of building construction, material and energy savings that can ensure sustainable infrastructure and general well-being of the residents.

Unit II	Costing, Cost Monitoring and Cost Control in Infrastructure	(8 Hrs)
To understand fundamentals of costing in infrastructure project, methods of cost monitoring and cost control in infrastructure projects (with some case studies) & understanding dynamics between Cost vs Cash Flow vs Working Capital management in an infrastructure project (with live case studies)		
Unit III	**Quantitative Methods in Project Management**	**(7 Hrs)**
To equip students with quantitative methods useful for project management. The tutorial in the course will help prepare students to develop the necessary skills required for analyzing and solving various real-life project management-related problems.		
Unit IV	**Risk Assessment and Mitigation in Infrastructure Project**	**(7 Hrs)**
To understand the Risks associated with Infrastructure Projects in India from Contractor's perspective and mitigation measures during Pre-Bid stage and Execution Stage		
Unit V	**Value Engineering**	**(7 Hrs)**
With increasing emphasis now being placed on cost improvement in both industry and government, Value Engineering has become a much-needed management tool and technique than ever before. This course is being offered towards meeting this need of key management technique and the major contributor for improving our product leadership and cost effectiveness.		
Unit VI	**Environmental Geotechnology**	**(8 Hrs)**
To learn concepts of environmental technology leading to the planning and disposal of waste in engineered landfills involving geosynthetic materials.		

Learning Resources
Reference Books: 3. The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004. 4. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010. 5. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008. 6. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009.
MOOC / NPTEL Courses: **5.** https://onlinecourses.swayam2.ac.in/arp19_ap75/preview **6.** https://archive.nptel.ac.in/courses/105/102/105102195/ **7.** https://onlinecourses.nptel.ac.in/noc21_de07/preview

JSPM University Pune

Faculty of Interdisciplinary Studies

School of Doctoral Studies and Research

Course Type: PCC	**Course Title: Advanced Concrete Technology**	
Course Code: **240GCED01**	**Teaching Scheme: 03 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 03 Hrs./Week** **Tutorial (T): --** **Practical (P): --** **Experiential Learning (EL): --**	**CIE: 100 marks** **ESE: 100 marks**

Prerequisite Courses, if any:

1. Concrete Technology

Course Objectives:

- To provide an in-depth understanding of types of cementitious material, admixtures and special concrete
- To cultivate knowledge regarding durability and micro structure of concrete

Course Outcomes: On completion of the course, learner will be able to

CO1: To understand the fundamentals of cement production and supplementary cementitious materials
CO2: To explore the role of admixtures in enhancing the properties of concrete
CO3: To examine the properties and applications of special concretes
CO4: To understand the challenges and advancements in the field of concrete 3D printing
CO5: To analyze the factors affecting the durability of concrete structures
CO6: To investigate the microscopic structure of concrete and its influence on macroscopic properties

Course Contents

Unit I	**Cement and Supplementary cementitious materials**	**(8 Hrs)**
Cement production, cement composition, cement classification, cement chemistry, supplementary cementitious materials: Specifications of fly ash, silica fume and GGBFS for use in concrete, reaction mechanism		
Unit II	**Admixture**	**(8 Hrs)**
Chemical admixtures: Water reducers, Air entraining agents, understanding concrete rheology, Viscosity modifying agents, Shrinkage reducing admixtures Mineral Admixtures: Introduction, classification and pozzolanic activity, GGBFS, Metakaolin and LC3, Agricultural ashes - characterization techniques and Life Cycle Assessment		
Unit III	**Special Concretes**	**(7 Hrs)**
High strength concrete and ultra high-performance concrete, Self-compacting concrete, Fibre reinforced concrete, Mass concreting and lightweight concrete, High density concrete, Ready Mix Concrete		
Unit IV	**3D printing of Concrete**	**(7 Hrs)**

Conventional construction vs 3D Printing, evolution of the technology, Construction 3D printing techniques, Steps in Additive Manufacturing of concrete, Rheology of fresh concrete, testing rheological behaviour, Quality control of hardened 3D-printed concrete		
Unit V	**Durability of concrete**	**(7 Hrs)**
Creep, Shrinkage, Sulphate attack, Chloride ingress, carbonation, freezing and thawing Corrosion of steel reinforcement in concrete, Experiments on durability index: Rapid chloride permeability test, Oxygen permeability test, and Water absorption test, Sorptivity test. Life cycle assessment of concrete		
Unit VI	**Microstructure of Concrete**	**(8 Hrs)**
Micro structural characterization of cementitious materials, Scanning Electron Microscopy, Applications of EDX with SEM, TEM		

Learning Resources

Text Books:

3. P.K. Mehta & P.J.M. Monterio, "*Concrete and its Microstructure*", ICI, Third Edition
4. A.M. Neville, "*Properties of Concrete*", Pearson Education, Fifth Edition

Reference Books:

9. V. S Ramachandran and James J.Beaudoin, "*Handbook of Analytical Techniques in Concrete Science and Technology*", Elsevier, First Edition
10. A.M. Neville & J.J. Brooks, "*Concrete Technology*", Addison- Wesley, Second Edition
11. ACI Manual of Concrete practice.
12. Jay G. Sanjayan, Ali Nazari, Behzad Nematollahi, "*3D Concrete Printing Technology: Construction and Building Applications*", Butterworth- Heinemann (Elsevier), First Edition 2019.

MOOC / NPTEL Courses:

8. NPTEL Course "*Advanced Topics in the Science and Technology*", Prof. Ravindra Gettu, IIT Madras.
Link of the Course: https://archive.nptel.ac.in/courses/105/106/105106187/

9. NPTEL Course "*Admixtures and Special Concretes*", Prof. Manu Santhanam, IIT Madras.
Link of the Course:https://onlinecourses.nptel.ac.in/noc23_ce61/preview

JSPM University Pune Ph. D. Course Work		
Course Type: PSMC	**Course Title: Foundations of Mathematical Modelling and Statistical Techniques**	
Course Code: 230GMAD01	**Teaching Scheme: 3 Hrs. / Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any: Matrices

Course Objectives:

- To make students familiarize with concepts and techniques that will enhance their analytical and logical thinking.

Course Outcomes: On completion of the course, the learner will be able to

CO1: Understand about Mathematical Modeling
CO2: Know Continuous Models Using ODE
CO3: Explain Miscellaneous Examples
CO4: Understand basics of Statistics
CO5: Explain Probability
CO6: Solve Research Problems

Course Contents

Unit I	About Mathematical Modeling	(8 Hrs)

What is Mathematical Modeling, History of Mathematical Modeling, Importance of Mathematical Modeling, Limitations of Mathematical Modeling
Introduction to Discrete Models
Linear Models Population Model Involving Growth, Newton's Law of Cooling, Drug Delivery Problem, Economic Model (Harrod Model), Linear Prey-Predator Problem, Non-Linear Models, Density Dependent Growth Models

Unit II	Continuous Models Using Ordinary Differential Equations and Partial Differential Equations	(8 Hrs)

Introduction to Continuous Models
Formation of Various Continuous Models, Carbon Dating, Drug Distribution in the Body, Growth and Decay of Current in an L-R Circuit Rectilinear Motion under Variable Force, Mechanical Oscillations, Horizontal Oscillations, Vertical Oscillations, Steady State Solutions, Linearization and Local Stability Analysis
Introduction, Different Mathematical Models Using Diffusion, Fluid Flow through a Porous Medium, Heat Flow through a Small Thin Rod (One Dimen-
sional) Wave Equation, Vibrating String, Traffic Flow

Unit III	Miscellaneous Examples	(6 Hrs)

Miscellaneous Examples on linear and nonlinear models based on real world problems

Unit IV	Statistics	(8 Hrs)

Measure of Central Tendency
: Mean, Median Mode, Standard deviation, Quartile deviation, Coefficient of variation (For frequency and grouped distribution)

Measure of Dispersion
: Raw Moments, Central Moments, Coefficient of skewness, Coefficient of Kurtosis

Correlation
: Karl Pearson's correlation coefficient, Positive correlation, Negative correlation

(Gradient Descent, Cost function)

Regression
Curve fitting**:** Least square method, regression of x on y, y on x, multidimensional regression

Unit V	Probability	(8 Hrs)

Probability
: Basic probability, conditional probability, probability theorems

Probability distribution function
: Poisson distribution, Normal Distribution, Chi- square test.

Unit VI	Research Problems	(7 Hrs)

Case Study

Learning Resources

Text Books: (Maximum 2)

1. Mathematical Modelling Models, Analysis and Applications – Sandeep Banerjee (CRC Press)
2. Gupta S. P & Gupta M.P., Business Statistics, Sultan Chand & sons, Delhi; Fundamental of Mathematical Statistics

Reference Books:

1. Mathematical Modelling and Simulation, Kai Valten (Wiley WCH)
2. An Introduction to Mathematical Modelling, Michael D Alder
3. Mathematical Modelling - JN Kapur
4. Sheldon M. Ross, "Introduction to Probability And Statistics For engineers And scientists" Academic Press Elsevier, 5th Edition
5. An Introduction to Statistical Methods, Vikas Publishing House

JSPM University Pune Ph.D. Course work		
Course Type: RMC	**Course Title: Writing Research Proposal**	
Course Code: **230IRMD02**	**Teaching Scheme: 1 hr./ Week**	**Examination Scheme:**
Credits: 1	**Lecture (L): 1** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**OR: 50 Marks**

Prerequisite Courses, if any:

1.
2.

Course Objective:

To have an overall concept Writing Research Proposal

Course Outcomes: At the end of course, Students will be able to

CO1: To understand the purpose and significance of a research proposal.
CO2: To develop a clear and well-structured research question or hypothesis
CO3: To create a research plan with a detailed methodology.
CO4: To write a coherent and persuasive research proposal.
CO5: To receive constructive feedback and make necessary revisions.
CO6: To know the utility of different types of software for Research Proposal

Course Contents

Unit I	Introduction to Research	(5 Hrs)
Introduction to Research Proposals - Importance and role of research proposals. - Overview of the course structure and objectives. - Selecting a research topic, Defining Research Questions and Objectives - Crafting clear research questions and objectives		
Unit II	**Literature review in the context of a proposal**	**(5 Hrs)**
Literature review in the context of a proposal. - Identifying the significance and relevance of the research, Research. Methodology - Choosing appropriate research methods. - Data collection and analysis techniques. - Ethical considerations in research.		
Unit III	**Structuring the Research Proposal**	**(5 Hrs)**
Structuring the Research Proposal - Introduction and background. - Research questions and hypotheses. - Methodology section, Review of Related Work - Importance of citing relevant literature. - Synthesizing existing research. - Gap identification		
Unit IV	**Writing Style and Organization**	**(6 Hrs)**
Writing Style and Organization - Clarity, conciseness, and coherence in writing. - Formatting guidelines and citation styles. - Abstract and executive summary, Peer Review and Feedback - Peer review of research proposals. - Incorporating 'feedback. - Revising and improving the proposal.		
Unit V	**Presentation and Defence**	**(5 Hrs)**

Presentation and Defense - Preparing a presentation of the research proposal. - Responding to questions and defending the proposal. - Preparing for the next steps in the research process.		
Unit VI	**Software Demonstration**	**(4 Hrs)**
Overleaf, Notion, Grammarly, Miro, Pandoc, Scinapse, Docear, Zenodo, Trello, Zoho Writer, Slack		

Learning Resources

Test Books:

1. Research Proposals: A Practical Guide, Martyn Denscombe, Open University Press (August 1, 2012)
2. Write a Winning Research Proposal: How to Generate Grant Ideas and Secure Funding Using Research Project Canvas, 2023, Martins Zaumanis, Independently Published By Peer

Reference Books:

1. Developing a Mixed Methods Proposal: A Practical Guide for Beginning Researchers, Jessica Decuir-Gunby, September 29, 2016, Paul A. Schutz, SAGE Publications, Inc.
2. Research Proposals: A Guide to Success, Thomas E. Ogden, Israel A. Goldberg, June 24, 2002, Academic Press; 3rd edition.

JSPM University Pune Ph.D. Course work		
Course Type: RMC	**Course Title: Writing Literature Review**	
Course Code: **230IRMD03**	**Teaching Scheme:**	**Examination Scheme:**
Credits: 2	**Lecture (L): 2** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**OR: 100 Marks**

Prerequisite Courses, if any:

1.
2.

Course Objective:

To have an overall concept Writing Literature Review

Course Outcomes: At the end of course, Students will be able to

CO1: To define and refine research questions or objectives.
CO2: To conduct a comprehensive and systematic literature search.
CO3: To critically evaluate and analyze academic literature.
CO4: To synthesize information from diverse sources.
CO5:.To develop a well-structured and organized literature review.
CO6: To understand the useful software for literature review.

Course Contents

Unit I	Introduction to Literature Review	(5 Hrs)

Introduction to Literature Review - Understanding the purpose of a literature review. - Different types of literature reviews. - Defining research questions and objectives, Literature Search Strategies - Effective database search techniques. - Identifying and accessing relevant sources. - Citation management tools.

Unit II	Critical Evaluation of Literature	(5 Hrs)

Critical Evaluation of Literature - Assessing the quality and credibility of sources. - Identifying gaps and limitations in existing research. - Ethical considerations in literature review. - Methods for synthesizing information. - Creating a conceptual framework. - Structuring your literature review

Unit III	Writing the Literature Review	(5 Hrs)

Writing the Literature Review and Peer review - Writing strategies and techniques. - Common mistakes to avoid. - Proper citation and referencing. - Peer review of literature review drafts. - Incorporating feedback. - Revision and finalization.

Unit IV	Presenting and Defending	(4 Hrs)

Presenting and Defending the Literature Review - Preparing a presentation of the literature review. - Responding to questions and defending the review. - Preparing for the next steps in research. - Reflect on the learning experience. - Discuss the relevance of the literature review to Ph.D. research. - Resources for ongoing literature review support.

Unit V	Techniques for conducting literature reviews	(4 Hrs)

Academic Databases: - Google Scholar: A freely accessible search engine for scholarly articles, theses, books, and conference papers. - PubMed: A database specializing in biomedical and life sciences literature. - IEEE Xplore: For research in electrical engineering, computer science, and electronics. - JSTOR: Contains a wide range of academic journals, books, and primary sources.

Reference Management Software: - EndNote: Helps in organizing references, creating bibliographies, and integrating with word processors. - Zotero: A free and open-source tool for managing and citing research sources. Mendeley: Combines reference management, PDF organization, and academic social networking.

Systematic Review Software: - Covidence: Designed for systematic reviews, it aids in screening and data extraction. - Rayyan: A web and mobile app for screening and collaboration in systematic reviews.

Unit VI	**Software for conducting literature reviews**	**(7 Hrs)**

Literature Review Software: - Seiwheel: Streamlines the literature review process with features for organizing, annotating, and sharing references. - Synthesis: Designed for systematic reviews and evidence synthesis with advanced data management features.

Citation and Bibliography Generators: - Citation Machine: Generates citations in various formats. - BibTeX and BibLaTeX: Popular tools for formatting references in LaTeX documents.

Search Engines and Alerts: - Library Databases: University and institutional libraries often provide access to specialized databases and search engines. - Google Alerts: Set up alerts for specific keywords to receive notifications of new research in your field.

Mind Mapping and Note-Taking Software: - Evernote: Helps in taking and organizing notes, and it's accessible from various devices. – Mind Meister: A web-based mind mapping tool to visually organize ideas and concepts.

Learning Resources

Test Books:

1. LITERATURE REVIEW SIMPLIFIED: A Practical Guide for Beginners, Rafiq Muhammad, July 21, 2022, Independently published.
2. The Literature Review: Six Steps to Success Fourth, Lawrence A. Machi, Brenda T. McEvoy, January 3, 2022, Corwin; Fourth edition.

Reference Books:

1. Writing Literature Reviews, Jose L. Galvan, Melisa C. Galvan, April 12, 2017, Routledge.
2. Preparing Literature Reviews: Qualitative and Quantitative Approaches, M Ling Pan, M Ling Pan, July 13, 2017, Routledge; 5th edition.

JSPM University Pune Ph.D. Course work		
Course Type: RMC	**Course Title: Research and Publication Ethics**	
Course Code: **230IRMD01**	**Teaching Scheme: 2hrs./ week**	**Examination Scheme:**
Credits: 2	**Lecture (L): 2** **Tutorial (T): --** **Practical (P): --** **Experiential Learning (EL):**	**TH: 100 Marks**

Prerequisite Courses, if any:

1.
2.

Course Objective:

To have an overall concept Research and Publication Ethics

Course Outcomes: At the end of course, Students will be able to

CO1: To define and refine Philosophy and Ethics.
CO2: To understand the scientific Conduct.
CO3: To critically understand the Publication Ethics.
CO4: To know the Open Access Publication.
CO5:.To be aware the Publication Misconduct.
CO6: To understand the Database and Research Metrices.

Course Contents

Unit I	Philosophy and Ethics	(3 Hrs)

Introduction to philosophy: definition, nature and scope, concept, branches.
Ethics: definition, moral philosophy, nature of moral judgements and reactions

Unit II	Scientific Conduct	(5 Hrs)

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data

Unit III	Publication Ethics	(7 Hrs)

Publication ethics: definition, introduction and importance, Best practices I standards setting initiatives and guidelines: COPE, WAME, etc., Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributorship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals PRACTICE

Unit IV	Open Access Publication	(4 Hrs)

I. Open access publications and initiatives 2. SIERPA/RoM130 online resource to check publisher copyright & self-archiving policies :L Software tool to identify predatory publications developed by SPPU 4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Unit V	Publication Misconduct	(4 Hrs)

Subject specific ethical issues, ITP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad Use of plagiarism software like Turnitin, Urkund and other open source software tools		
Unit VI	**Database and Research Metrices**	**(7 Hrs)**
Indexing databases, Citation databases: Web of Science, Scopus, etc. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, 1PP, Cite Score, Metrics: h-index, g index, HO index, altmetrics		

Learning Resources

Test Books:

1. Bird, A. (2006). Philosophy of Science. Routledge.

2. Mactntyre, Alasdair (1967) A Short History of Ethics. London.

3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, 1SBN:978- 9387480865

4. National Academy of Sciences, National Academy of Engineering and institute of Medicine. (2009).

Reference Books:

5. On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.

6. Resnik, a B. (2011). What is ethics in research & why is it important. National institute of Environmental Health Sciences, 1-10. Retrieved from hitns://www,niehsmili.govIR;setrchiresourcesibioethiesiwhatislindex.cfm

7. Beall, S. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489179a

8. Indian National Science Academy (NSA), Ethics in Science Education, Research and Governance(2019), ISBN:978-81-939482-1-7. http://www.insa.india.rcs,in/pdf/Ethics _Book.pdf