

CSIR Postgraduate Research Programme in Engineering

**Two-year PG Research Programme
In
Engineering of Structures
At
SERC, Chennai**



Brochure

(2010-2011)

**Structural Engineering Research Centre,
Council of Scientific and Industrial Research
Taramani, Chennai 600113.**

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**Two-year PG Research Programme
In
Engineering of Structures
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Structural Engineering Research Centre (SERC), Chennai**

Our PG research program and curricula related to the course **Engineering of Structures** provide education and training through a holistic approach to structural engineering, by emphasizing and building on the commonality in materials, mechanics, and analysis considerations across the disciplines engineering. The program features strong components in laboratory experimentation, basic theory, information technology, and engineering design. The course also provides in-depth exposure to the engineering concepts, scientific principles, research methodology and hands-on experience on advanced real-life R&D projects in different specializations of Structural Engineering. The post graduate research program is aimed at training selected number of students as highly skilled professionals in Civil engineering with the proper academic and engineering credentials to assume leadership roles in industry, research and academia.

The first two semesters of the programme focuses on core subjects related to Engineering of Structures. The second and third semesters offer elective courses. The third and fourth semesters give the opportunity to the candidates to effectively utilize the knowledge acquired through the courses towards advanced R&D project work and dissertation in their specialization areas.

The medium of instruction and evaluation is English.

Number of Seats in the Programme

The total number of seats available is 10.

Admission Process and Eligibility for Admission

Fresh Engineering graduates in Civil engineering. Please see the CSIR website, <http://www.csir.res.in/>, for more information.

Fellowship

Please see the CSIR website, <http://www.csir.res.in/>, for more information.

Programme Fee Structure

Please see the CSIR website, <http://www.csir.res.in/>, for more information.

The fees/charges need to be deposited before the start of every semester. In addition, service taxes, if any, applicable need to be paid along with the fees.

For NEFT bank transfer, please transfer the amount to the saving account number 30225927924 of Director, SERC, SBI, Taramani (IFSC code SBIN0010673) with appropriate narration statement.

In case of Demand Draft, please get it issued in favour of “IRF- SERC” payable at Taramani, Chennai and post it by speed post or registered letter to “Director, SERC, Chennai – 600 113” with your name written in pencil on the reverse side of the demand draft.

Important Dates

Please see the CSIR website, <http://www.csir.res.in/>, for more information.

The detailed programme calendar will be made available before the start of each semester.

Laboratory facilities:

Structural Engineering Research Centre (SERC), Chennai, India is one of the national laboratories under the Council of Scientific & Industrial Research (CSIR), India. SERC has built-up excellent facilities and expertise for the analysis, design and testing of structures and structural components. Services of SERC are being extensively used by the Central and State Governments and public and private sector undertakings. Scientists of SERC serve on many national and international committees and the Center is recognised at the national and international levels as a leading research institution in the field of structural engineering. SERC has recently been certified as ISO: 9001 quality institution.

Mandate:

SERC acts as a clearing house for the latest available knowledge and develops know-how on design and construction of all types of structures

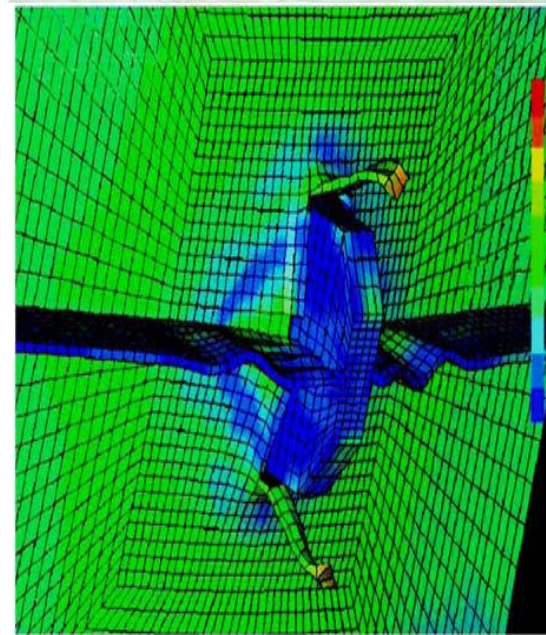
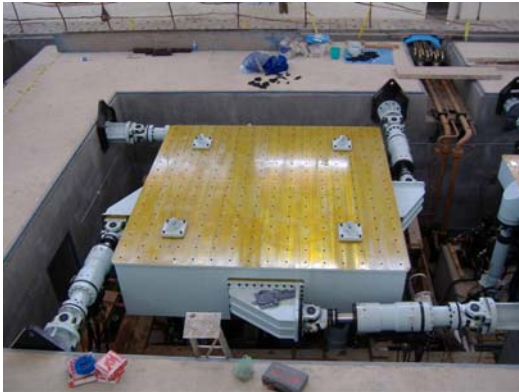
It undertakes application-oriented research in all aspects of structural engineering – both design and construction, including rehabilitation of structures

It provides design consultancy services, including proof checking, to organisations in the public and private sectors for developing a variety of structural designs

SERC also organises specialised courses on structural engineering for the benefit of practicing engineers to familiarise them with the latest developments in analysis, design and construction

Research & Development Areas

- Advanced Seismic Testing and Research Laboratory
- Computer Aided Analysis & Design of Structures
- Concrete Composites Laboratory
- Concrete Structures
- Construction Engineering Laboratory
- Experimental Mechanics Laboratory
- Fatigue Testing Laboratory
- Steel Structures
- Tower Testing and Research Station Facilities
- Wind Engineering Laboratory



Spectrum of Activities / Services

- **In-house Research & Development Projects**
- **Sponsored R&D Projects**
- **Grant in Aid Projects**
- **Consultancy Projects**
- **Inter- Lab & International Collaborative projects**
- **Tower Testing Services**
- **Technical Services**
- **Conduct/organize Advanced Courses/seminars/ workshops, etc.**
- **Release of Technology / know-how**
- **Information Dissemination - JOSE, Research Alert**

Special lectures on varied topic of academic relevance, other than curriculum, are held every week under Lecture series.

A number of conferences, symposia and workshops are organized by the faculty which attracts participation from scholars all over the world.

The Institute maintains collaborations with several other institutes in the world through scientists exchange programs. The scientists/faculty of the Institute have distinguished themselves through awards for academic activity from national as well as international organizations.

SERC, Chennai has set a fine example of interaction with the industry in the country, through consultancy and technical services offered by the scientist. Innovative ideas are put to practice in many projects sponsored by other institutions in India.

SERC publishes a bi-monthly Journal of Structural Engineering (JoSE) as an open forum on structural engineering / mechanics, for papers that have advanced scholarly value or interest. There are more than 350 subscribers, from India and abroad.

Amenities in the Campus

Hostels

Separate hostel accommodation for male and female students is made available. The students are required to abide by the Hostel/Mess Rules in force.

Recreation

The Staff Club of SERC organises various activities related to club tours, sports and games, health related lectures / camps for its members. It is also, in coordination with CSIR Sports Promotion Board, organizing various sports events for men and women for indoor and outdoor games.

Canteen

The departmental canteen facility is available in the campus for break-fast and lunch and other snacks etc, at nominal rates. (Besides, there are several private eateries/ cafeteria in the vicinity of campus)

Vigyan Auditorium / Lecture Hall / Seminar Hall / Conference Room

SERC campus houses a-state-of-the-art 'Vigyan' auditorium (400 seating capacity), Lecture hall (100), Seminar hall (80) and conference rooms (40 and 30) with computerized data projection systems and Audio-Visual facilities.

IT Infrastructure

The SERC LAN (Modified star topology) was established in the year 1996 with Fibre optic backbone between buildings spread across the wide campus. Each node in the campus is connected with the centralized networking facility. The campus-wide intranet communication is via the centrally Managed Layer 3 Switch.

Internet Connectivity:

SERC is provided with 3 Mbps (uncompressed) bandwidth for its Internet facility through RF as last mile connectivity.

Intranet

Facilities are provided with LAN at different departments for connecting their desktops with the campus-wide LAN. The campus-wide LAN is extended to TTRS, Trisoolam through radio frequency (RF) link.

E-mail facility

An in-house web based mailing facility is being provided to the staff of SERC. The CSIR e-mail facility is also being extended.

Information Security

The security of the computers in the campus-wide LAN has been enhanced with the installation of firewall. Centralized anti-virus software installed and every desktop connected to the campus-wide LAN.

Video Conference Facility

State-of-the-art video conferencing facility has been established recently, enabling effective interaction among the CSIR labs.

Web Server

An in-house web server hosting the SERC portal is being maintained and this has been designed and developed using Oracle Application Server 10g. The Web based intranet application modules are also being deployed on the SERC Web server with Oracle 10g as the backend database from time to time.

Biometric Attendance Facility

A finger based biometric attendance system has been established at SERC. 11 biometric units have been installed at various locations in the SERC campus and 2 in the TTRS campus. These units are connected to the centralized server through the campus wide LAN.

Library

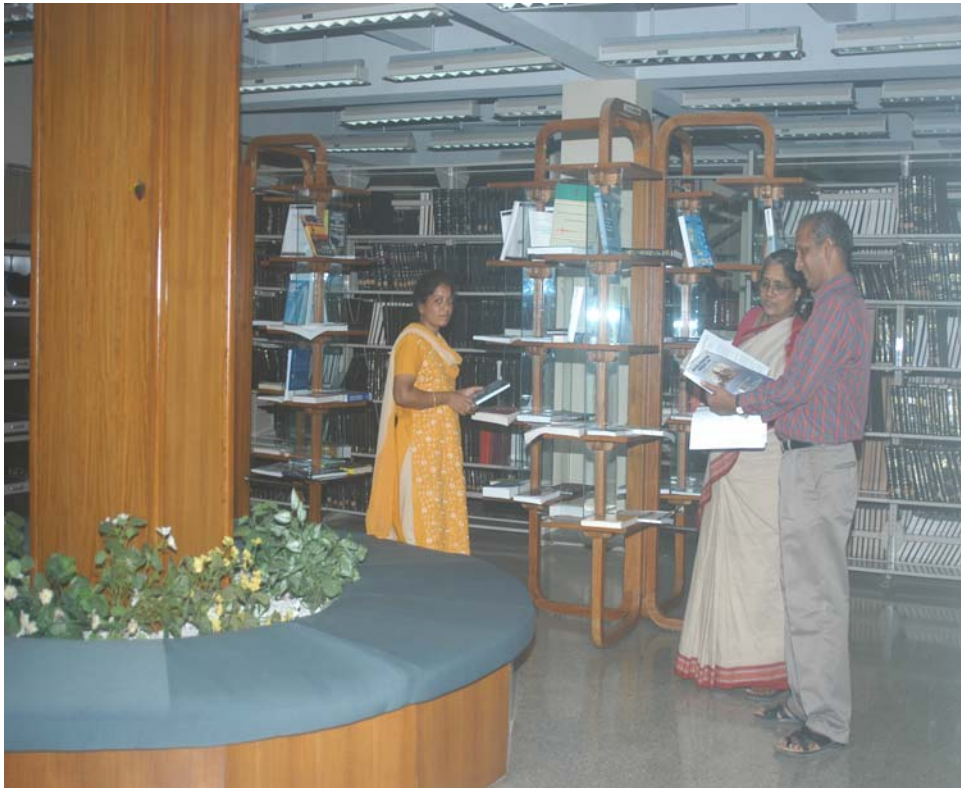
SERC Library has the total collection of 1336 about 14000 books. The Library subscribes to 74 foreign and 29 Indian journals. In addition, journals are being received through membership and exchange. The Library has a stock of over 2000 microfiches. Photocopying services and a microfiche reader facility is also available.

The Library has a large number of International Standards of about 3444, such as American, British, Canadian, Japanese, German and Russian. Also codes from organizations such as the American Society of Mechanical Engineers (ASME), American Association of State Highway and Transportation Officials (AASHTO), International Conference of Building Officials (ICBO), etc have been added to the Library collection. In addition, the Library holds a stock of doctoral dissertations from the University Microfilms International (UMI) and NTIS reports and microforms. It has about 9400 bound volumes in its collection.

The Library is automated, both for in-house operations and for information storage and retrieval. A machine readable catalogue is available for the users for various searches. The Library is also a part of the campus network and hence users can access on-line the various databases available in the Library from their respective workstations. The “AutoLib” software has been customized to provide Library services on the Campus Intranet.

The Library is a member of the American Concrete Institute (ACI), Cooling Technology Institute (CTI), Federation International du Beton (FIB), International Association for Bridge and Structural Engineering (IABSE), Indian National Science Academy (INSA), Construction Industry Development Council (CIDC), Consultancy Development Centre (CDC), Indian Institution of Bridge Engineers (IIBE), Indian Buildings Congress (IBC), Computer Society of India (CSI), Institute for Steel Development & Growth (INSDAG), Multidisciplinary Center for Earthquake Engineering Research (MCEER), The British Council Library, International Committee on Industrial Chimneys (CICIND) and IDARC 2D Users Group.

The Library is a part of the CSIR Consortium on e-journals and has online access to over 3300 journals published by leading international publishers such as Elsevier, Wiley Interscience, Springer, American Society of Civil Engineers, Blackwell, American Society of Mechanical Engineers, Oxford University Press, American Chemical Society, the Royal Society of Chemistry, Web of Science, Nature, ASTM Standards and Indian Standards.



Semester-wise Scheme for Engineering of Structures (STRUCTURAL ENGG)

Semester-I (SERC)

Subject Code	Subject	Credit
serCE401	Instrumentation & Sensors for Measurement of structures/Structural Components	4
serCE402	Advanced Mechanics of Materials	4
serCE403	Computational Methods	4
serCE404	Advanced Engineering Mathematics	4
serCE406	Dynamics of Structures	4

Semester-II

Subject Code	Subject	Credit
serCE4xx	Elective 1	4
serCE4xx	Elective 2	4
serCE4xx	Elective 3	4

Electives for 2nd semester (SERC)

Subject Code	Subject	Credit
Elective 1		
serCE414	Earthquake Engineering	4
serCE416	RCC & Prestressed Concrete	4
Elective 2		
serCE421	Plates & Shell Structures	4
serCE422	Metal Structure Behaviour & Design	4
Elective 3		
serCE417	Finite element technology-I	4
serCE419	Soft Computing	4

Semester-III

Subject Code	Subject	Credit
serCE4xx	Elective 4	3
serCE4xx	Elective 5	3
serCE1251	Project Work and Seminar	12

Electives for 3rd semester (SERC)

Subject Code	Subject	Credit
Elective 4		
serCE423	Health monitoring of Structures	3
serCE411	Bridge Engineering	3
serCE454	Engineering for Natural hazards	3
serCE452	Repair & Rehabilitation of Concrete Structures	3
Elective 5		
serc E453	New Composite materials in Civil Engineering applications	3
serCE418	Uncertainty Handling in Engineering Decision Making	3
serCE456	Finite Element Technology-II	3
serCE458	Fatigue & Fracture of Engineering Structures	3

Semester-IV

Subject Code	Subject	Credit
serCE 481	Dissertation Seminar and Viva-voce	4
serCE 1462	Dissertation Report	14

SERCE401: Instrumentation & Sensors for Measurement of structures/Structural Components

(3-0-1) 4 Credits

PF : Shri K. Srinivas (CSIO), Dr. K. Ravisankar, Dr. S. Arunachalam

Introduction: Definition of Instrumentation, Why instrumentation of Structures/Structural components? concepts and Methods - Potential areas of application; measurements: Data Acquisition - Data Transmission - Data Processing - Storage of processed data - Knowledgeable information processing - Remote Structural Health Monitoring; Sensors for measurements: Electrical Resistance Strain Gages (ERSG), Vibrating Wire Strain Gages (VWSG), Fiber Optic Sensors (FOS), Temperature Sensors, Accelerometers, Displacement Transducers, Load Cells, Humidity Sensors, Crack Propagation Measuring Sensors, Corrosion Monitoring Sensors, Pressure Sensors

SERCE402 : Advanced Mechanics of Materials (3-0-1) 4 Credits

PF : Dr. Nagesh R Iyer , Dr. G.S. Palani

Concept of Stresses and Strains - Basic Concepts, Mechanical Behaviour of Materials, Stress and strain tensors, Thermal Stresses; Mechanical Properties of Engineering Materials - Stress-Strain Curve of Engineering Materials, Constitutive relations ; Solid Mechanics Approach - Principal Stresses and Strains, Axially Loaded Members, Plane stress, Plane Strain and Axisymmetric Problems, Closed and Open Coiled Helical Springs, Strain energy, Introduction to concepts of plasticity ; Bending and shear of beams - Shear Forces and Bending Moments, Bending and Shear Stresses, Elastic Deflection of Beams ; Torsion – Open and closed sections, Shear centre, warping cross-section properties, Shear flow in closed and open sections, Torsion of shafts, closed and open sections; Advanced Topics - Buckling of Compressed Members and Slenderness Ratio, Elements of Structural Vibrations, Fundamentals of Fatigue Analysis

SERCE403 : Computational methods (3-1-0) 4 Credits

PF: Dr. A. Rama Mohan Rao , Dr. J. Rajasankar

Introduction, finite floating point arithmetic, catastrophic cancellation, chopping and rounding errors; Solution of nonlinear equations; bisection method, secant method, Newton's method, fixed point iteration, Muller's method; Numerical optimization; Method of golden section search, Newton's method optimization; Solutions of linear algebraic equations; forwarding Gaussian elimination, pivoting, scaling, back substitution, LU-decomposition, norms and errors, condition numbers, iterations, Newton's method for systems, computer implementation; Interpolation; Lagrange interpolation, Newton interpolation, inverse interpolation; Numerical Integration; finite differences, Newton cotes rules, trapezoidal rule, Simpson's rule, extrapolation, Gaussian quadrature; Numerical solution of ordinary differential equations; Euler's method, Runge-Kutta method, multi-step methods, predictor-corrector methods, rates of convergence, global errors, algebraic and shooting methods, for boundary value problems, computer implementation

SERCE404 :Advanced Engineering Mathematics (4-0-0) 4 Credits

PF: Dr. K. Balaji Rao; Dr. N. Gopalakrishnan

Ordinary Differential Equations of the First Order , Ordinary Linear Differential Equation, Laplace Transformation, Line and Surface Integrals. Integral Theorems, Matrices and Determinants (Systems of Linear Equations), Fourier Series and Integrals, Partial Differential Equations, Sequences and Series, Taylor and Laurent Series, Special Functions. Asymptotic Expansions

SERCE406: Dynamics of Structures (3-0-1) 4 Credits**PF: Dr. N. Lakshmanan, Dr. K. Muthumani**

Introduction: dynamic vs. static response; types of dynamic loading: seismic, impact, wind, blast; Principles of dynamics - Formulation of equations of motion by different methods - single degree of freedom systems - free and forced response - effect of damping; Multi-degree of freedom systems -Formulation of equations of motion - Eigen values problems - Modes shapes and orthonormality of modes -Approximate methods of extraction of eigen values and natural frequency; Seismic response spectra Response spectra parameters; response spectra relationships; Dynamic response of MDOF systems - Mode superposition techniques - Numerical integration procedures; Continuous systems - Modeling - free and forced vibration of bars and beams; MDOFs : Response spectra analysis; Response spectra analysis; SRSS and CQC combination methods; Introduction to frequency domain analysis; Time domain vs. frequency domain; Fourier series; the fast Fourier transform (FFT);assessing frequency content; frequency based filtering; Application of finite element method in structural dynamics

SERCE411: Bridge Engineering (2-1-0) 3 Credits**PF: Dr. N. Lakshmanan, Dr. K. Ramanjaneyulu**

Introduction - historical development, Classification and components of bridges, choice of type of the bridges, bridge aesthetics; Bridge codes – standard specifications for highway and railway bridges; Analysis and design of RC and PSC bridge decks, load distribution in slab and girder bridges, analysis and design of voided slab bridge decks, behaviour of skew bridge decks; Analysis and design of RC and PSC box-girder bridge decks; Analysis and design of steel and composite bridges; Design of bearings; Design of substructure and foundations - piers and abutments of different types, shallow and deep foundations; Modern methods of construction - Incremental launching and its impact on analysis and design, segmental construction ; Introduction to analysis and design of long span bridges: suspension and cable stayed bridges

SERCE414: Earthquake Engineering (2-0-1) 3 Credits**PF: Dr. N. Lakshmanan, Dr. K. Muthumani, Shri N. Gopalakrishnan**

Elements of Engineering Seismology - Causes of earthquakes - seismic waves – magnitude and intensity - characteristics of strong earthquake ground motions - Seismic Susceptibility of Indian Subcontinent; Performance of structures under past earthquakes - Lessons learnt - Behaviour of RC, steel, Masonry and prestressed concrete structures under cyclic loading; Introduction to theory of vibrations -Flexibility of long and short period structures - concept of response spectrum; Building forms for earthquake resistance - Building Systems – Rigid Frames, Braced Frames, Shear Walls - Structural Configuration; Seismic design philosophy - Concept of Earthquake Resistant Design - Evaluation of earthquake load on structures based on IS: 1893 – response spectrum method - 3 D computer analysis of building – Importance of detailing IS 13920 Seismic Design of Non Engineered construction; Seismic evaluation and retrofitting of structures; Soil performance – Soil liquefaction – Soil structure interaction ; Seismic design provisions for bridges, dams, tanks and Industrial structures; Modern Concepts: Introduction to Passive and Active Control of Civil Engineering Structures, Base Isolation, energy dissipation devices, Adaptive systems – Case studies

SERCE416: RCC & Prestressed Concrete structures (3-0-1) 4 Credits**PF: Dr. K. Ramanjaneyulu, Dr. B. H. Bharath Kumar ; Shri A. Rama Chandra Murthy**

Yield line method of Design of Slabs: Equilibrium and virtual work methods of analysis, Rectangular slabs and triangular slabs with various edge conditions – yield line patterns, Circular slabs, Design for limit state of strength and serviceability, Orthotropically reinforced slabs; Design of Grid Floors: General features, Rigorous and approximate methods of analysis, Design of grid floors.; Design of Shear walls; Design of Deep Beams and Corbels; Design of Flat Slabs; Design of bunkers silos and chimneys; Analysis of stresses in concrete chimneys- uncracked and cracked sections- Codal provisions- Design of chimney; Importance of Detailing in Reinforced Concrete Construction.

Introduction to prestressed concrete: materials, types of prestressing systems and devices; analysis of prestressed concrete elements for flexure: concepts of stresses at transfer and service loads, ultimate strength in flexure, losses in prestress, anchorage zone stresses; philosophy of design: limit state design for flexure and shear, tendon profiles in post-tensioned and pre-tensioned members, comparative analysis of provisions of international standards; statically indeterminate structures: continuous beams and portals, secondary moments,

concordancy of tendon profiles ; composite construction: longitudinal shear transfer, transverse shear, stage prestressing, creep and shrinkage effects; external prestressing; design of prestressed concrete pipes, tanks, slabs, and cylindrical shells.;construction aspects – prestressing, precast-prestressed concrete, stressing sequence; safe demolition of psc structures; methods for safe distressing of prestressed concrete structures

SERCCE417: Finite Element Technology-I (3-1-0) 4 Credits

PF: Dr. Nagesh R Iyer , Dr. A. Rama Mohan Rao , Dr. J. Rajasankar , ,

Review of matrix methods of structural analysis ; Stationary Principles, Rayleigh-Ritz method and Interpolation : Principle of stationary potential energy, Rayleigh-Ritz method, Stationary principles and governing equations, Finite element form Rayleigh-Ritz method, FEM formulation from a functional, Interpolation, C_0 and C_1 elements; **Displacement based Element formulations:** Overview of element stiffness matrix, Load formulations, Equilibrium and compatibility, convergence requirements , patch test, stress calculations, plane stress, plane strain, axisymmetric and solid finite elements, triangular, quadrilateral, tetrahedron and hexahedron elements. **Isoparametric finite elements :** 1-D, 2-D and 3-D shape functions, Lagrangian and Serendipity family of elements, numerical integration, validity of isoparametric elements, element and mesh instabilities, coordinate transformations, handling of constraints; **Plate bending elements :** Plate bending theory, Mindlin and Kirchhoff element formulations, Concepts of locking, Full, reduced integration and selective reduced techniques,

SERCE418: Uncertainty Handling in Engineering Decision Making (3-0-0) 3 Credits

PF: Dr. K. Balaji Rao

Introduction: Basic Definitions; Examples; Different types of uncertainties; Exposure to formal frameworks for handling uncertainties; Theory & Application of Probability and Statistics: Nature and Purpose of Mathematical Statistics; Tabular and Graphical Representation of Samples; Sample Mean and Sample Variance; Random Experiments, Outcomes, Events; Probability; Permutations and Combinations; Random Variables. Discrete and Continuous Distributions; Mean and Variance of a Distribution; Binomial, Poisson, and Hypergeometric Distributions; Normal Distribution; Distributions of Several Random Variables; Random Sampling. Random Numbers; Estimation of Parameters; Confidence Intervals; Testing of Hypotheses, Decisions; Quality Control; Acceptance Sampling; Goodness of Fit. χ^2 -Test; Nonparametric Tests; Pairs of Measurements. Statistical Tables; Application of stochastic processes for engineering decision making : Basic definition of stochastic process; Some commonly used stochastic processes; Learning models for engineering decision making – learning in both stationary and non-stationary environment; Application of fuzzy sets in engineering decision making :Basic definition of fuzzy sets; Some commonly used fuzzy sets; Use of fuzzy stochastic models for engineering decision making; Handling of uncertainties using possibility and plausibility theories ; Introduction to application of game-theoretic approaches for engineering designs

SERCE419: Soft Computing (3-1-0) 4 Credits

PF: Dr. A. Rama Mohan Rao

Introduction: Introduction of Soft-computing tools, Fuzzy Logic, concepts meta-heuristics, Evolutionary algorithms, Neural Networks and Probabilistic Reasoning; Artificial Neural Networks (ANN): Different Architectures, Back-propagation Algorithm, Hybrid Learning Rule, Supervised Learning- Perceptrons, Adaline, Back-propagation Multilayer Perceptrons, Radial Basis function Networks. Unsupervised Learning – Competitive Learning Network, Kohonen Self-Organizing Networks, Hebbian Learning, The Hopfield Network; Support Vector Machines: Support vector machines and other kernel based learning algorithms, Implementation techniques for SVM, application of SVM for engineering problems; Fuzzy Set Theory: Basic Definition and terminology, Basic Concepts of Fuzzy Logic, Set Theoretic Operators, Membership functions- formulation and parameterization. Fuzzy Union, Intersection, and Complement. Fuzzy Rules and Fuzzy Reasoning. Fuzzy Inference Systems- Mamdani and Sugeno Fuzzy models. Fuzzy Associative Memories; Evolutionary Algorithms: Basics of evolutionary Algorithms, Design issues in evolutionary Algorithm, evolutionary computing; Applications with Soft Computing Tools: Case studies with ANN, fuzzy and Hybrid approaches

SERCE421 :Plate and shell structures (4-0-0) 4 Credits

PF: Dr. K. Ramanjaneyulu, Dr. G.S. Palani

Thin plates, Kirchhoff theory - strain displacement relations, stresses and stress resultants, constitutive equations, equilibrium equations, boundary conditions, Analysis of rectangular and circular plates with different boundary conditions and loadings ; thick plates-Reissner-Mindlin-Naghadi type theories; orthotropic plates, plates on elastic foundation; Buckling of plates; Membrane and bending theory for analysis of singly curved and doubly curved shells – long and short cylindrical shells, single and multi barrel shells, Beam-arch approximation for long cylindrical shells; Analysis of surfaces of revolution – domes, cylindrical, conical and hyperboloid of revolution subjected to different types of loadings; Analysis and shells of translation - elliptic paraboloids, hyperbolic paraboloids; Analysis of folded plates; Finite elements for analysis of plate/shell structures

SERCE422: Metal Structure behaviour and Design (3-0-1) 4 Credits

PF: Dr. S.J. Mohan, Dr. G.S. Palani , Dr. S. Arul Jayachandran,

Frame design review -Second Order Effects and Moment Magnification; Stability and Leaning Columns; Philosophies of design - ASD vs. LRFD and Structural Reliability; Failure Criteria; Brittle Fracture/Ductile Yielding; Von Mises Yield Criteria; Fatigue - Stress Life, Strain Life, Fracture Mechanics; Variable Amplitude Loading and Miner's Rule; Fatigue Design Requirements; Bending behavior - General Flexural Theory; Unsymmetrical Bending Biaxial Bending Tapered Members; Torsion - Pure Torsion Shear Flow Shear; Center of Open Thin-Walled Sections Uniform Torsion; Torsion of Structural Shapes; Non-uniform Torsion; Combined Torsion and Bending Torsion of Closed Thin-Walled Sections, Single Cell and Multi-Cell; Lateral torsional buckling - Elastic and Inelastic; Columns, plates, and compression members - Local Buckling of Plate Elements; Design Criteria; Torsional Compression Buckling; Design of Aluminum Structures: Introduction, Stress-Strain Relationship, Permissible Stresses, Tension and Compression Members, Laced and Battened Columns, Beams; Beam-column and frame behavior –Approximate 2nd order effects; Elastic and Inelastic Behavior; CONNECTIONS - Review of Bolt and Weld Strength; Riveted and Bolted Connections Design Aids Example; Microwave Towers – Introduction, structural configuration, function, analysis and design. Transmission Towers – Introduction, structural configuration, bracing systems, analysis and design, codal provision for design of tower and foundation; Tubular Structures - Tubular Trusses, joint details, tubular scaffoldings, codal provisions; Cold Form light gauge section- Type of cross section, Stiffened, multiple stiffened and un-stiffened element, flat- width ratio, effective design width, Design of light gauge compression, tension and flexural members

SERCE423: Health Monitoring of structures (2-0-1) 3 Credits

PF: Dr. K. Ravisankar, Shri N. Gopalakrishnan

Static Field Testing: Requirements for carrying out static field testing -Types of static tests - Behavioural/Diagnostic tests - Proof tests - Simulation and loading methods - Static response measurement; Dynamic Field Testing: Stress history data - Dynamic load allowance tests - Ambient vibration tests - Forced Vibration Method - Dynamic response methods; Periodic and Continuous Monitoring; Long term performance monitoring using integrated sensing methods - Monitoring through ambient vibration - Monitoring through testing under service load conditions - Assessment of crack growth - Loss of prestress; Data Acquisition Systems; Static data acquisition systems - Dynamic data acquisition systems - Hardware for Remote data acquisition systems; Remote Structural Health Monitoring: Importance and Advantages - Methodology - RF/PSTN/GSM/Satellite Communications - Networking of sensors - Data compression technique; Case Studies

SERCE452: Repair & Rehabilitation of Concrete Structures (2-0-1) 3 Credits

PF: Dr. B.H. Bharthkumar, Shri T.S. Krishnamurthy, Dr. M. Neelamegam

General: Introduction , cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations ,experimental investigations using NDT, load testing, corrosion mapping, core drilling method; Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors; Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects. Assessment procedure for evaluating a damaged structure; Causes of deterioration – testing techniques;

Techniques for Repair: Corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection. Strengthening of structural elements with various methods; Case Studies: Structures affected due to corrosion related failure

SERCE453: New Composite materials in Civil Engineering applications (2-0-1) 3 Credits

PF: Shri T.S. Krishnamurthy, Dr. J.K. Dattatreya, Dr. J. Annie Peter

Concrete Composite: Fresh concrete and hardened concrete – Mix Design – Use of Admixtures Mechanical and Durability properties; Fibre Reinforced Concrete (FRC):Types of Fibres – Factors affecting strength and stiffness of fibre concrete– Production of FRC – Tests on FRC – Applications of FRC; ferrocement-production and application; High Performance Concrete (HPC): Definition – Constituent materials – Production methods – Advantages of HPC – Applications of HPC; self compacting concrete; definition – constituent material – mix proportion – production methods – various tests on SCC – applications of SCC; Polymer Concrete Composite: Classification of Polymer concrete – Methods of Production – Advantages of Polymer Concrete – Applications of Polymer Concrete; FRP composites: Constituent materials – Method of Productions – Properties and Production method – Applications

SERCE454: Engineering for Natural hazards(3-0-0) 3 Credits

PF:Dr. S. Arunachalam, Dr. S. Selvirajan, Dr. K. Balaji Rao

Hazard Characteristics: Seismology and ground motion characteristics; Extreme wind Characteristics; Hazard Estimation: Deterministic methods; Stochastic methods; Probabilistic and deterministic seismic hazard analysis; Risk analysis of cyclonic wind speed; Post Disaster Damage Surveys: Earthquake Disaster; Cyclone Disaster; Materials and Methodology of Constructions; Vulnerability Analysis: Damage Probability Matrix approach; Fragility Analysis approach; Risk analysis life quality index Approach; Guidelines for Disaster Resistant Structures: Earthquake Disaster; Cyclone Disaster

SERCE456: Finite Element Technology-II(2-1-0) 3 Credits

PF: Dr. Nagesh R Iyer, Dr. A. Rama Mohan Rao, Shri J. Rajasankar, Dr. G.S. Palani

Structural mechanics – Introduction to truss, beam, frames, bending of plates and shells, shells of revolution, springs, gap and contact finite elements, locking issues and solutions related to plate/shell finite elements Introduction of FEA for Dynamic problems – Mass and damping formulations, Free vibration analysis, Mode superposition, Direct time integration – Implicit & explicit techniques; Introduction to nonlinear FEA – Concept of geometric and material nonlinearity, Total and updated Lagrangian formulation, Constitutive relations, Solution techniques; Error estimation and adaptive refinement techniques – *A posteriori* error estimation for static, vibration and dynamic problems; h-, p-, r- and mixed adaptive refinements

SERCE458: Fatigue & Fracture of Engineering Structures (2-1-0) 3 Credits

PF: Dr. G. Raghava, Dr. G.S. Palani, Shri P. Gandhi, Shri T.S. Krishnamurthy

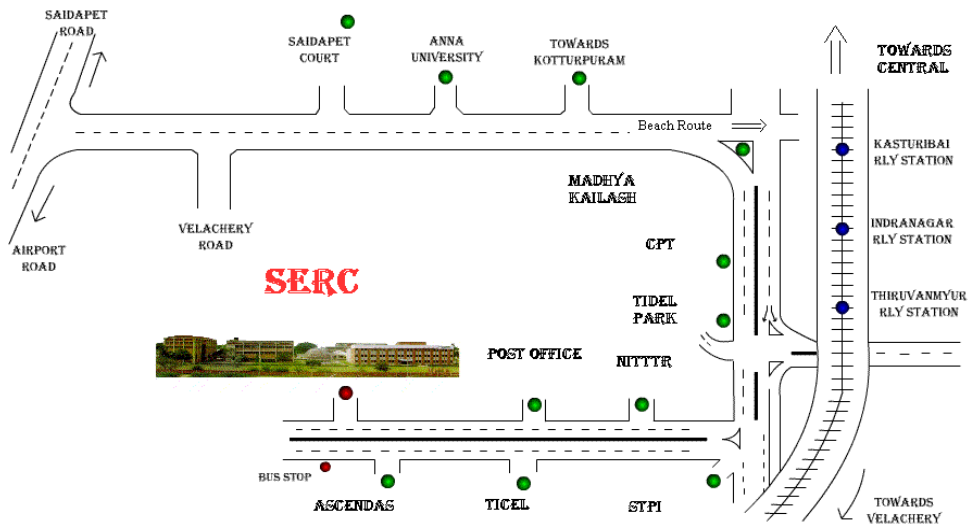
Introduction to Fatigue: Loads – Cyclic loads – High cycle fatigue – Low cycle fatigue; Stress-life Approach: S-N curve – Size effect – Loading effect – Surface ... plating, thermal, and mechanical – Temperature – Environment; Strain-life Approach: Introduction – Material behaviour – Monotonic stress-strain behaviour, Basic definition – True and engineering stress-strain relationship, Cyclic stress-strain behaviour, Cyclic strain hardening and softening, Cyclic stress-strain curve determination, Stress-strain power law relation; Fatigue Life Calculation: – Prediction of fatigue life using S-N and Miner's approach – General, calculation of equivalent stress range, stresses to be considered, S-N curves and joint classifications, – Prediction of crack propagation using da/dN vs ΔK curves – General, Constant amplitude loading, variable amplitude loading, geometric functions and crack growth integrals– General, load calculation, stress calculation, ... probability of failure – Design formats – General, allowable stresses, allowable cumulative damage ratio, comments on the design formats; Fracture:...Stress distribution at discontinuities – Stress concentration factors – Cracks ... Linear Elastic Fracture Mechanics (LEFM):Stress intensity factor – *monotonic and cyclic loads* - Fracture toughness – Energy theories – *J*-integral; Crack Growth Studies: Fatigue crack growth ... Constant amplitude loading – Variable amplitude loading – Crack growth models –Remaining life prediction – Residual strength evaluation – Plastic collapse condition, Yield condition, Remaining life approach ... Fracture of Concrete Structures: Fracture mechanics approach for concrete – Limitations – Nonlinear fracture models with tension softening – Fracture energy – size effect – Remaining life prediction – Residual strength evaluation

List of Faculty (SERC)

S.No	Name	Designation	Field of Expertise
1	Dr. Nagesh R Iyer	Director	Computational Mechanics, Fatigue & Fracture
2	Dr. N. Lakshmanan	Former Director & Advisor (Projects)	Structural Dynamics and Wind Engineering
3	Dr. S. Arunachalam	Scientist G	Wind Engineering, cyclone disaster mitigation
4	Dr. K. Ravishankar	Scientist G	Experimental Mechanics, health monitoring
5	Dr. K. Muthumani	Scientist G	Structural Dynamics , Earthquake Engineering
6	Shri T.S. Krishnamurthy	Scientist G	RCC design, Repair & Rehabilitation of Structures
7	Dr. M. Neelamegam	Scientist G	Concrete composites, special concrete
9	Dr. J. Annie Peter	Scientist F	Concrete composites, special concrete
10	Dr. Selvi Rajan	Scientist F	Wind Engineering, cyclone disaster mitigation
11	Dr. P.K. Umesha	Scientist F	Steel Structures, Optimisation
12	Dr. S.J. Mohan	Scientist F	Steel Structures, tower testing
13	Dr. G. Raghava	Scientist F	Fatigue and Fracture
14	Dr. K. Balaji Rao	Scientist F	Risk and Reliability
15	Dr. A. Rama Mohan Rao	Scientist F	Computational mechanics, Combinatorial optimisation
16	Dr. K. Ramanjaneyulu	Scientist F	Bridge Engineering , RCC design
17	Shri N. Gopalakrishnan	Scientist F	Structural Dynamics , Earthquake Engineering
18	Shri J. Rajasankar	Scientist F	Computational Mechanics, Damage Mechanics
19	Dr. G.S. Palani	Scientist EII	Computational Mechanics, Fatigue and Fracture
20	Dr. S. Arul Jayachandran	Scientist EII	Steel Structures, computational mechanics
21	Shri P. Gandhi	Scientist EII	Fatigue and Fracture
22	Dr. J.K. Dattatreya	Scientist EII	Concrete composites, special concrete
23	Dr. B.H. Bharthkumar	Scientist EII	RCC design, fracture of concrete structures
21	Shri K. Srinivas	SIC (CSIO)	Sensor technologies, Non conventional energy
22	Dr P. Harikrishna	Scientist EII	Wind Engineering, CFD
23	Shri S.G.N. Murthy	Scientist EII	Non Destructive testing
24	Shri P. Srinivasan	Scientist EII	Non Destructive testing, Concrete structures
25	Shri G. Ramesh Babu	Scientist EI	Wind Engineering, CFD
26	Shri A. Rama Chandra Murthy	Scientist C	RCC design, Fracture mechanics

Evaluation Procedures and Grading Scheme

The two-year programme is made up of 4 semesters with continuous internal evaluation and a semester-end examination for all courses. Letter grades will be awarded for each course reflecting the student's proficiency and instructor's expectation. For further details on evaluation procedure and grading scheme, please see the CSIR website, <http://www.csir.res.in/>.



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