



Master of Technology
in
Building Engineering & Disaster Mitigation
(BEDM)
Leading to
Integrated MTech - PhD programme
Brochure 2015 - 17



Offered by



CSIR - Central Building Research Institute
Roorkee - 247667, Uttarakhand

**MTech
in
Building Engineering & Disaster Mitigation (BEDM)
CSIR - CBRI, Roorkee**

Preamble

With the initiative of Government of India on creation of infrastructural facilities a large sum of money is being invested in the construction sector. With huge shortage of housing in all the economic sectors and the importance attached to the growth and development of the housing sector in the country it is expected that the country is going to see a new horizon in the housing industry in near future. The concepts of Make in India, Innovate in India, Smart Cities, Smart Villages, Clean and Renewable Energy and Affordable Housing are fast catching up in the country.

Recognising the importance of housing, one of the prime infrastructures required for the growth of the country, the CSIR - Central Building Research Institute, Roorkee (CBRI), one of the prime laboratories of CSIR is offering an integrated programme leading to Master of Technology (MTech) in “Building Engineering and Disaster Mitigation (BEDM)” and PhD in engineering and sciences. The integrated programme is so designed that a successful candidate will receive both MTech and PhD degree on completion of the programme while opportunity exists for the candidates who wish to quit the programme after two years of successful completion with an MTech degree in BEDM.

The theme of disaster mitigation fulfils adequately the requirement of mitigating the risk of earthquake, landslide and fire which often destroy the infrastructures and create havoc. The country has seen many such disasters in the past. The multidisciplinary expertise required to meet the requirements are available in the institute and the course is designed to impart practical training to the students on these themes. Thus the course is a perfect blend of both theory and practice. Drawing from the rich experience of scientists working in this laboratory, the course is designed to offer to the participants sound theoretical knowledge and practical site experience. Such a unique opportunity is not available anywhere in the country. Also the programme is unique by itself.

Number of Seats in the Programme

The total number of seats available for the integrated programme is 10 (Ten).

Admission Process and Eligibility for Admission

Engineering graduates who have completed B.Tech / B.E / B.Sc(Engg) in Civil Engineering / Construction Engineering / Building Science and Technology or are expected to complete successfully by October 2015 are eligible for the programme. Please see the CSIR website, <http://www.acsir.res.in> for more information.

Fellowship

Please see the website, <http://www.acsir.res.in/>.

Programme Fee Structure

Please see the website, <http://www.acsir.res.in/>.

The fees/charges are required to be deposited before the start of every semester. For NEFT bank transfer, please transfer the amount to the saving account number 30269847968 of Director, CBRI, SBI, Roorkee (IFSC code SBIN0010635) with appropriate narration statement. In case of Demand Draft, please get it issued in favour of "Director CBRI" payable at Roorkee, and post it by speed post or registered letter to "Director, CSIR-CBRI, Roorkee, Uttarakhand, Pin - 247667" with your name written in pencil on the reverse side of the demand draft.

Important Dates

Please see the website, <http://www.acsir.res.in/>, for more information. The detailed programme calendar will be made available before the start of each semester.

Evaluation Procedures and Grading Scheme

(Details are given in the AcSIR Handbook available at www.acsir.res.in)

A number of course works are to be completed as a part of the programme primarily in the first two semesters and a few courses spread over other semesters as stipulated are to be taken. The evaluation process for the course is continuous with a semester-end examination. Letter grades will be awarded for each course reflecting the student's proficiency and instructor's expectation. The grades and their description along with their equivalent numerical values, where applicable, are as follows:

GRADE	POINTS	REMARKS	GRADE	POINTS	REMARKS
A+	10	Outstanding	A	9	Excellent
B+	8	Very Good	B	7	Good
C+	6	Fair	C	4	Poor
F+	2	Very Poor	I	0	Incompleted

"I" grade shall be given to students who have (i) Not Attended Classes; and/or (ii) Not been evaluated. This implies repeating the full course and appearing in the examination so that it could be considered towards final grade calculation.

Performance of the student will be evaluated by two indices, SGPA and CGPA. These will be calculated as follows:

$SGPA = \{\text{Sum of (Course credit * Numerical value of course grade)}\} / \text{Total course credits earned in the semester}$

$CGPA = \text{Cumulative grade points scored in all passed courses} / \text{Cumulative credits earned}$

A student needs to have a SGPA of 6.0 (in each of the first and second semesters) or above and a CGPA of 6.5 (at the end of the second semester) or above for continuing beyond the first year. Minimum grade point to be earned to pass any subject is 6.0. The time period to complete the MTech programme is two years and that for PhD is four years. Extension, if needed beyond the stipulated period for completing the courses will be decided on a case by case basis.

Weightage of marks during the semester

There will be one mid-semester and one end semester examination in each semester. Before and after the mid-semester examination there will be two class tests. The end semester examination will have 40% weightage. The mid semester examination will have 30% weightage and the two class tests will have 10% weightage each. The balance 10% weightage will be given to the tutorials, assignments and general discipline etc in respective subjects.

Examination & Evaluation procedures for Thesis work

- Every student shall have at least one thesis supervisor from amongst the faculty members of the Institute. No student can have more than

two supervisors from the same Institute. However, another co-supervisor from outside the institute, if necessary, may be appointed.

- The appointment of supervisors is normally done keeping in view the student's aspirations and the research interest of the faculty / institute.

For Thesis work

- The thesis Oral Examination Board (OEB) shall be constituted by the Director of the laboratory on recommendation of Coordinator and thesis supervisor for each student. The OEB will have minimum three members one examiner from same field of research, one examiner from areas other than the candidate's field of research and the thesis supervisor(s). The Dean approves the committee and senate chairman subsequently ratifies it. The communication in this regard would be done by the Lab Coordinator.
- The candidate, at the earliest, would be allowed to submit the thesis two weeks before the completion of the fourth semester with recommendation of the thesis supervisor(s).
- The last allowable date for submission of the MTech thesis is 15th May of every Calendar year.
- The notification of the open seminar would be circulated by the thesis supervisor in consultation with members of the OEB.
- The candidate shall present his / her thesis work physically in colloquium (Open Seminar) in presence of the OEB members.
- The candidate is considered to have passed the oral examination if all the OEB members consider that the performance of the candidate is satisfactory with award of grade C⁺ or above.
- Based on the presentation and responses to the questions raised during oral examinations, the committee may recommend re-submission of the thesis at most once after incorporating the suggestions made by the committee for evaluation.
- In the rescheduled oral examination, the OEB must declare the candidate either to have passed or failed. There shall not be any recommendation for third oral examination.

About CSIR-CBRI



Introduction

CSIR - Central Building Research institute (CBRI), Roorkee, Uttarakhand, India is one of the National laboratories under the Council of Scientific & Industrial Research (CSIR), India. CSIR- CBRI has built-up excellent facilities and expertise in all the branches of building science and technology e.g. Geotechnical Engineering, Structural Engineering, Building Materials,

Building Engineering & Disaster Mitigation (BEDM)

Environmental Science and Technology, Architecture and Planning, Efficiency of Buildings, Acoustics Instrumentation & Mechanical Systems and Fire Research Engineering. In fact fire research laboratory of the institute is a unique facility in the country. The institute has vast experience in disaster mitigation. Over the years, the institute has developed expertise and facilities in mitigating disasters of different types.

Services of CSIR - CBRI are being extensively used by the Central and State Governments and public and private sector undertakings. Scientists of CSIR -CBRI serve on many national and international committees and the Institute is recognised at the national and international levels as a leading research institution. The institute very actively takes part in the formulation of Indian Standard Specifications.

Vision

A world class research & knowledge center of national importance for providing innovative solutions to all aspects of building science & technology.

Mission

Dedicated to research, development and innovation (RD&I) in solving national challenges of planning, design, materials, capacity building and construction including disaster mitigation in buildings to achieve safety, sustainability, resilience, smartness, comfort, functional efficiency, speed, productivity in construction, environment preservation, energy efficiency and economy.

Focus

- Strategies for creating sustainable built environment for improving quality of life
- Scientific RD&I in niche areas such as virtual construction to disaster resilience
- To be an institute of global repute for providing innovative and sustainable building solutions

Research & Development Groups

- Geotechnical Engineering
- Structural Engineering
- Organic Building Materials

- Environmental Science and Technology
- Architecture and planning
- Efficiency of Buildings
- Fire Research Engineering and
- Acoustics, Instrumentation and Mechanical systems
- Polymer, Plastic & Composites

Spectrum of Activities / Services

- In-house Research & Development Projects
- Sponsored R&D Projects
- Grant in Aid Projects
- Consultancy Projects
- Inter- Lab & International Collaborative and network projects
- Technical Services
- Conduct/organize advanced courses/seminars/workshops/industry meets, etc.
- Release of Technology / know-how
- Information Dissemination

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

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/faculties of the Institute have distinguished themselves through awards for academic activity from national as well as international organizations. CSIR-CBRI, Roorkee has set a fine example of interaction with the industry in the country, through consultancy and technical services offered by the scientists. Innovative ideas are put to practice in many projects sponsored by other institutions in India.

IT Infrastructure

Internet Connectivity

CSIR-CBRI is provided with 16 Mbps (uncompressed) bandwidth for its Internet facility. Also 1 Gbps National Knowledge Network (NKN)

connectivity has helped the institute to get connected with the leading institutes of the country.

Video Conference Facility

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

Library

Library, now known as Knowledge Resource Centre (KRC), is a hub of research activities of the institute. A state of the art RFID system is put in place. The centre has both e-learning facilities and reading through hard copies.

Collection, collation and communication of documents and as repository of knowledge resources in the field of building science and technology and related areas for providing specified information services using various sources of information in print/electronic media and adopting developments in information and communication technology (ICT) for making services much more effective, exhaustive, dynamic and almost instantaneous to its valued users i.e. S&T community is the focus of the knowledge resource centre.

Information Base

Library has a rich collection of books, journals and non book materials that include:

Print

- 43,000 books include text books, reference books, technical reports, manuals, conference proceedings, standards, theses, maps etc.
- 19500 Bound volumes of journals collection since 1950
- 109 current subscription to journals (61 foreign + 48 Indian) in print form
- Full text reprints of research publications of S&T members of CBRI
- Collection of Annual Reports of CSIR labs. CSIR as well as other leading scientific institutions
- 56 numbers of microfilms

Online

- Access to over 3000 full text e-journals available on line (access & download facility) of all international leading scientific publishers like Wiley interscience, Springer, Sage, Elsevier, ASCE, Oxford University press, American Chemical society, IEEE, Emerald, Nature, T&F, Institution of Civil engineers, UK, (ICE), London as under CSIR-DST e-journals Consortium.
- Access of Indian journals under Indian journals.com
- Available on line standards database viz. ASTM and Indian (BIS)
- International Construction Database (ICONDA) on CD-ROM since 1976 & now online available
- International patent database: Derwent Innovation Index & Delphion
- Access of science bibliographic database like Web of Science (WOS) cover SCI
- Other utility database like JCCC

Institutional Membership

Library is a member of a number of national & international organizations and institutions like

National

1. Indian Building Congress (IBC)
2. Indian Geotechnical Society (IGS)
3. Institute for Steel Development & Growth (INSDAG)
4. Indian Science Congress Association (ISCA)
5. Life Member of the Institution of Engineers (India), Kolkata
6. Life member of Indian Academy of Science for 'Current Science' journal
7. Life member of 'Disaster Management Institute' (DMI), Bhopal

International

1. International Council for research & Innovation in Building & Construction (CIB), The Netherlands
2. International Union of Laboratories & Experts in Construction, Materials & Structures (RILEM), France
3. International Federation for Structural Concrete (FIB), Switzerland

Services

- Documents circulation
- On line search (OPAC) for in house library database on LAN using Libsys software
- CD-ROM search facilities as well as online available for international database and Indian standards (CED)
- On line access of E-journals (Full text)
- On line patent search
- On line science database search
- Current Awareness Services: a) List of latest additions b) News paper clippings
- Reprographic services
- Inter library loan
- Reference service
- AC reading hall

Major Research Areas:

- Innovative & Alternate Materials
 - Green Buildings
 - Affordable Housing
 - Conservation of Heritage Structures
 - Tall Building and Steel Structures
 - Smart Cities
 - Smart Villages
 - Disaster Mitigation

Details of the Institute (CSIR - CBRI):

Year of establishment -- 1947

e-mail: director@cbri.res.in

Phone: (01332) 283323

Fax: (01332) 272272

Web site address: www.cbri.res.in

Name of the Director: Dr Girish Sahni

Name of the AcSIR Lab Co-ordinator: Dr S.R. Karade

Degrees offered : MTech (started from July 2010)

Integrated MTech-PhD (started from January 2012)

PhD in Civil Engg., Geosciences and Chemical Sciences

Major R&D Projects

SUPRA INSTITUTIONAL NETWORK PROJECT

- Innovative Materials and Technologies for Next Generation Green Buildings (INMATE - NGGB).

CSIR 800 PROJECT

- Dissemination, Training and Demonstration of Appropriate Rural Housing Technologies

NETWORK PROJECT

- Engineering of Disaster Mitigation and Health Monitoring for Safe and Smart Built Environment (EDMISSIBLE).

FUTURE RESEARCH PLANS UNDER THE FOLLOWING BROAD AREAS OF RESEARCH

- Development of Innovative & Alternate Materials
- Engineering of Disaster Mitigation
- Numerical Modelling
- Health Monitoring of Building Structures, Retrofitting
- Intelligent Building Systems
- Energy Efficient Systems
- Knowledge Dissemination through Societal Missions & Capacity Building

Research Facilities:

- Dual Cone Calorimeter (ISO: 5660 & ASTM E 1354)
- Fully computerized 1000 kN UTM and 3000 kN UTM
- Corrosion Analyzer “Field Machine”
- Computer controlled Laser Particle size Analyzer
- Computer controlled Triaxial and Consolidation testing system
- Foundation Pile Diagnostic system
- Geotechnical Instrumentation for performance evaluation
- Optical Microscope for petrographic studies of rocks & building materials
- Geo-radar

- Resistivity Imaging System
- Uniaxial Shake Table
- Atomic absorption spectrophotometer
- Infra-red spectrophotometer
- UV and visible spectrophotometer
- Ion selective analyzer
- Stack monitor
- Particle size analyzer
- Portable CO₂/CO/H₂S/ Hydrocarbon analyzer
- Cement testing laboratory
- Lime-pozzolana laboratory
- Thermal analysis laboratory
- X-ray diffraction equipment
- X-ray Florence equipment
- Nano particle synthesizer
- Inductive coupled plasma spectrophotometer
- Energy dispersive X-ray photometer
- Differential thermal analyzer
- Thermo-mechanical analyzer
- Xenon Arc Weatherometer
- Ozone Chamber
- Heavy Testing Laboratory
- Burning Behaviour of Materials for 'Reaction to Fire Studies'
- Toxicity apparatus
- Fire Detection, Extinguishment & Sprinklers Lab.
- Spherical vessel for explosion
- Wall furnace for fire resistance studies
- Floor furnace for fire resistance studies
- Low speed wind tunnel for ventilation and wind pressure distribution in buildings
- Standing wave apparatus for sound absorption coefficient at normal incidence
- Reverberation chamber for sound transmission loss and sound absorption coefficient at random incidence
- Dome type artificial sky for daylighting studies
- Ultrasonic and acoustic emission setup for non-destructive testing of building components

- Scanning Electron Microscope
- Low speed wind tunnel for ventilation studies.

Residential campus

The institute has sprawling 65 acres residential campus adjoining to the academic campus. A large number of amenities such as hostels for both boys and girls, dispensary, guest house, community centre, play grounds, common mess for the hostel residents, a shopping centre, bank with ATM facility, post office apart from the residential apartments exists in the campus. The residential campus is sandwiched between IIT Roorkee campus and the Bengal Engineering Group army base.

Dispensary

The campus has a dispensary equipped with residential Doctor, Pathologist and other dispensary staff. The dispensary caters the need of the residents. Only on emergency patients are transferred to nearby medical college or nursing home with a standby ambulance.

Hostels

Separate hostel accommodation for male and female students is available. The students are required to abide by the Hostel/Mess Rules in force. Messing facility is common for both girls and boys. The mess is equipped with air conditioned dinning hall, water cooler, large LCD wall TV with Dish connectivity etc. Hostels are equipped with internet facilities.

Recreation

The Staff Club and Ladies Club of CBRI organise various activities related to sports and games, Deepavali Fete, Illumination competition etc. These are also, in coordination with CSIR Sports Promotion Board, organizing various sports events for men and women for indoor and outdoor games.



Students Activities in the Campus

Abhivyakti

The students publish a quarterly wall magazine “Abhivyakti” to express their literary acumen.

Auditorium / Lecture Hall / Seminar Hall / Conference Room

CBRI campus houses an auditorium (Rabindranath Tagore auditorium with 260 seating capacity) and conference rooms with computerized data projection systems and Audio-Visual facilities.

Field Visits

Field visits are organised as a part of educational programme to impart the field knowledge and share the rich experience of the scientists for handling the projects at site.



Students during field visits at a construction site in Himalaya

Building Engineering and Disaster Mitigation (BEDM)

M.Tech. Course Structure

SEMESTER I			SEMESTER II		
Course Code	Course Title	L-T-P-C	Course Code	Course Title	L-T-P-C
ENG-CBRI 1-1101	Numerical Methods	3-0-0-3	ENG-CBRI 1-1102	Design of Building Structures	3-0-0-3
ENG-CBRI 1-1103	Advanced Geotechnical & Foundation Engineering	3-0-0-3	ENG-CBRI 1-1104	Disaster Resistant Building System-I	3-0-0-3
ENG-CBRI 1-1105	Engineering Materials for Infrastructure	3-0-0-3		Elective I	3-0-0-3
ENG-CBRI 1-1107	Analysis of Building Structure	3-0-0-3		Elective II	3-0-0-3
PHY/ENG-CBRI-1-0001	Research Methodology	1-0-0-1		Elective III	3-0-0-3
ENG-CBRI 1-1111	Laboratory - I (Geotechnical Engineering, Materials and Environmental Science & Technology)	0-0-4-2	ENG-CBRI 1-1106	Laboratory-II (Structural Engineering & Fire Engineering)	0-0-4-2
ENG-CBRI 1-1113	Seminar-I	0-0-2-1	ENG-CBRI 1-1108	Seminar-II	0-0-2-1
Total Credits		16	Total Credits		18
SEMESTER III			SEMESTER IV		
Course Code	Course Title	L-T-P-C	Course Code	Course Title	L-T-P-C
ENG-CBRI 1-1115	Disaster Resistant Building System-II	3-0-0-3	ENG-CBRI 1-1110	Dissertation-II including Viva Voce	0-8-24-20
ENG-CBRI 1-1117	Dissertation-I	0-4-16-12			
Total Credits		15	Total credits		20
Total Course Credits : 69					

For details of the Ph.D programme refer to the Ph.D brochure.

ELECTIVE COURSES

Course Code	Course Title
ENG-CBRI-1-1120	Concrete Technology
ENG-CBRI-1-1124	Industrialized Building Systems
ENG-CBRI-1-1126	Repair, Rehabilitation & Retrofitting of Building Structures
ENG-CBRI-1-1128	Environmental Impact Assessment
ENG-CBRI-1-1130	Sustainable Design & Energy Efficient Building Systems
ENG-CBRI-1-1132	Construction, Planning & Management
ENG-CBRI-1-1134	Fire Protection Engineering
ENG-CBRI-1-1136	Environmental Engineering & Management
PHY/ENG-CBRI- 1-1138	Rock Mechanics
ENG-CBRI-1-1140	Ground Improvement Techniques
ENG-CBRI-1-1142	Optimization Techniques
ENG-CBRI-1-1144	Deep Excavation
PHY/ENG-CBRI- 2-1102	Advanced Seismology
ENG-CBRI-2-1104	Health Monitoring of Building Structures
ENG-CBRI-3-1106	Tall Buildings & Structures
ENG-CBRI-3-1108	Behaviour of Metal Structures
ENG-CBRI-3-1110	Landslide Disaster Mitigation

Note : The electives will be selected by the students depending on their broad areas of research.

Core Courses

SEMESTER I

ENG-CBRI-1-1101		Numerical Methods	L-T-P-C 3-0-0-3
Syllabus	<p>Interpolation, errors, divided differences, polynomial approximation, numerical differentiation and integration, matrices: Eigen values and Eigen vectors, numerical solution of ordinary and partial differential equations and their convergence, initial and boundary value problem, Laplace and Poisson equations, special functions: Lagendre's function, Rodrigue's formula, Bessel's function and recurrence formula, finite element method and applications, fuzzy logic, artificial neural network and genetic algorithms.</p> <p>Introduction to the software- like Ms-Excel, SPSS and MATLAB</p>		
Reference Books	<ol style="list-style-type: none"> 1. S. R. K. Iyengar, R. K. Jain & M. K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International Publishers, 2003. 2. B. S. Grewal, Numerical Methods in Engineering & Sciences, Khanna Publishers, 2010. 3. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publishers, 2008. 4. S. Chakraborty & R. B. Bhatt, Numerical Methods in Engineering, Narosa Publ. House, 2004. 5. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall, 2012. 6. J. Mathew & K. Fink, Numerical Methods with MATLAB, Pearson Education, 2006. 7. C. F. Gerald & O. Patrick, Wheatley Applied Numerical Analysis, Addison Wesley, 1994. 8. O. C. Zienkiewicz, The Finite Element Methods, Tata McGraw Hill Publishing Co., 1971. 9. C. S. Desai & J. F. Abel, Introduction to Finite Element Method, Van Nostrand Reinhold, New York, 1972. 		
Faculty	Abha Mittal, P.K. Yadav and Manojit Samanta		

ENG-CBRI-1-1103		Advanced Foundation Engineering	L-T-P-C 3-0-0-3
Syllabus	<p>Shallow Foundation: Limit equilibrium analysis, Prandtl, Terzaghi, Vesic and Meyerhof's methods of analysis, safe and allowable bearing pressures, contact pressure distribution, rigid and flexible foundation, analysis of combined footings, elastic analysis of raft foundation, floating raft, foundation on slope, settlement calculations, elastic and consolidation settlement, Skempton-Bjerrum modification, bearing capacity and settlement calculation from penetration data, settlement tolerance, foundation model, soil-structure interaction studies.</p> <p>Deep foundation: Load transfer mechanism, critical length, comparison of different methods of analysis of pile foundation, group capacity, group efficiency, vertical capacity from pile-pile interaction factor, analysis of pile foundation subjected to moment, settlement under vertical load, lateral capacity of short and long piles, group lateral capacity, p-y and beam on elastic foundation approach, P-multiplier concept, single and group tensile capacity of pile foundation. Piled-Raft Foundation: Load transfer mechanism, estimation of vertical capacity from different approaches, estimation of settlement from different methods, lateral capacity, case studies.</p>		
Reference Books	<ol style="list-style-type: none"> 1. K. Terzaghi, R. B. Peck & G. Mesri, Soil Mechanics in Engineering Practices, Wiley Interscience Publication, 1996. 2. J. E. Bowles, Foundation Analysis and Design (4 ed.), McGraw Hill, New York, 1996. 3. H. G. Poulos & E.H. Davis, Pile foundation Analysis and Design, John-Wiley & Sons, New York, 1980. 4. M. J. Tomlinson, Foundation Design and Construction, Pitman Publishing Limited, London, 1975. 5. S. K. Gulhati & M. Datta, Geotechnical Engineering, Tata McGrawHill, 2005. 6. M. R. Hausmann, Engineering Principles of Ground Modification, McGraw Hill, 1990. 		
Faculty	Pradeep Kumar, Anindya Pain and Piyush Mohanty		

ENG-CBRI-1-1105 Engineering Materials for Infrastructure L-T-P-C 3-0-0-3	
Syllabus	<p>Evolutionary trends in construction materials: Traditional and innovation, Properties and functional requirements of materials, The choice of materials., New and alternate cements, Supplementary cementitious materials, Utilization of industrial wastes in cementitious binders, Wood substitutes: Development, Raw materials, Current production processes, properties and end use. Composites: Reinforcement, matrices, processing techniques and use in infrastructures. Polymers and plastics in buildings: Plastic products, Sandwich composites, Coatings & Sealants, and Polymer concrete. Construction chemicals: Water reducing agents, Consistency improvers, Accelerating admixtures, Set retarders, Corrosion inhibitors, permeability reducers, water repellents etc., Roofing, walling and flooring materials, Steel and non-ferrous materials.</p> <p>Performance and durability: Strength and deformation of materials, Fire behavior of building materials, Life cycle cost, Effect of environmental agents such as weathering, moisture, chemical attack, frost action and efflorescence. Performance and durability: Strength and deformation of materials, Fire behavior of building materials, Life cycle cost, Effect of environmental agents such as weathering, moisture, chemical attack, frost action and efflorescence.</p>
Reference Books	<ol style="list-style-type: none"> 1. K. S. Jagadish, B. V. V. Reddy & K. S. N. Rao, Alternative Building Materials and Technologies, New Age International, 2006. 2. R. Rixom & N. Mailvaganam, Chemical Admixtures for Concrete, 3rd Edition, E & FN Spon, 1999. 3. H. F. W. Taylor, Cement Chemistry, Thomson Telford, 1997. 4. C. A. Wilkie & A. B. Morgan, Fire retardency of polymeric materials, CRC Press, Taylor & Francis Groups, Boca Raton, USA, 2010.
Faculty	Rajni Lakhani, S.K.Singh and Harpal Singh

ENG-CBRI -1-1107 Analysis of Building Structures L-T-P-C 3-0-0-3	
Syllabus	<p>Static analysis: Fundamentals of elasticity, Static and kinematic indeterminacy, stiffness and flexibility methods, Finite element formulation of 1D, 2D and 3D problems and applications, Analysis of plane stress, plane strain, axi-symmetric and plate bending problems, Introduction to non-linear analysis.</p> <p>Dynamic analysis: Free and forced vibration of damped and undamped Single Degree Freedom systems (SDF), Harmonic excitations, vibration isolation, force transmissibility and support excitations, short duration impulse, Duhamel integral, time history analysis, Response spectra. Multiple degree of freedom systems, Orthogonality and normalization of modes, Solution methods for eigen values and eigen vectors, mode -superposition method, Computational programs for dynamic analysis.</p>
Reference Books	<ol style="list-style-type: none"> 1. S. P. Timoshenko & J. N. Goodier, Theory of Elasticity, McGraw Hill Education (India) Pvt Ltd, 1970. 2. J. M. Gere & W. Weaver, Matrix analysis of framed structures, Springer US, 1990. 3. H. C. Martin, Introduction to Matrix Methods of Structural Analysis, McGraw-Hill, 1966. 4. R. W. Clough & J. Penzien, Dynamics of Structures, McGraw-Hill, 1993. 5. Mario Paz, Structural Dynamics Structural Dynamics: Theory and Computation, Kluwer Academics Publisher, 2004. 6. K. J. Bathe & E. L. Wilson, Numerical methods in finite element analysis, Prentice-Hall, 1976. 7. R. D. Cook, D. S. Malkus, M. E. Plesha & R.J. Witt, Concepts and Applications of Finite Element Analysis, Wiley Publisher, 1989. 8. C.S. Krishnamoorthy, Finite Element Analysis-Theory & Programming, Tata McGraw-Hill, 1994. 9. Anil K Chopra, Dynamics of Structures, Theory and Applications to Earthquake Engg, 2nd Edition, Prentice - Hall of India Pvt. Ltd, 2004.
Faculty	Achal Mittal, S.K. Panigrahi and Micky Dalbehera

PHY/ENG-CBRI-1-0001		Research Methodology	L-T-P-C 1-0-0-1
Syllabus	<p>Introduction, Research terminology and the scientific methods; Designing and implementing a research project, Types of research; Measurements in research, Communicating research results, Case studies, Professional ethics, Ethics in Research, Plagiarism, Nuremberg code etc. Communication Skills, presentation, Inter-personal communication.</p> <p>Primary and secondary data, Statistical methods of data analysis.</p>		
Reference Books	<ol style="list-style-type: none"> 1. C. R. Kothari, Research Methodology: Methods and Techniques, New Age Publications, 2011. 2. Ranjit Kumar, Research Methodology: A Step-By-Step Guide for Beginners, SAGE publication, 4th edition, 2014 3. D K Bhattacharyya, Research Methodology, Excel Books India, 2009. 		
Faculty	Abha Mittal & S.R. Karade		

ENG-CBRI- 1-1111		Laboratory - I Geotechnical Engineering, Materials and Environmental Laboratory	L-T-P-C 0-0-4-2
Syllabus	<p>Geotechnical Laboratory: Physical properties and compressibility characteristics of soils, Drained and Undrained shear strength parameters and hydraulic properties of soil, Dynamic properties of soil, Field test: SPT, DCPT, Plate load, Vane shear test.</p> <p>Materials and Environmental laboratory: Testing of plastics building products: Plastic pipes (dimensions, hydrostatic pressure test, reversion etc.), Water storage tanks (dimensions, impact, tensile strength, resistance to deformation etc.), Door shutters (dimensions, edge loading test, buckling test, misuse, slamming etc.), Waterproofing membrane (sticking test, heat resistance test, water penetration test etc.).</p> <p>Instrumental methods for analysis: Scanning electron microscopy, X-ray diffraction, Thermal analysis, Inductive coupled plasma, X-ray florescence, surface area analyser etc. Air pollution test, water quality test, testing of cementitious materials, Micological and Termite Resistance Test.</p>		
Faculty	B. Singh, , L.P. Singh and Manojit Samanta		

Core Courses**SEMESTER II**

ENG-CBRI-1-1102 Design of Building Structures		L-T-P-C 3-0-0-3
Syllabus	<p>Design loads: earthquake and wind, load combinations, Design requirement. Concept and philosophy of earthquake resistant design of buildings: linear analysis, Codal provisions and methods, Masonry Concepts and Design, Advances in masonry modeling and simulation.</p> <p>Wind effects on buildings: Codal provisions Criteria for wind resistant design of buildings - Concept of wind engineering with reference to aerodynamics of bluff bodies, vortex shedding, Design of glass facades for buildings.</p> <p>Introduction to plastic analysis in steel structures: Concepts of LRFD design, Codal provisions, Design concepts of tall building system. Introduction to light gauge steel sections. Design of Industrial Buildings.</p> <p>Computer aided structural design.</p> <p>Introduction to Impact in RCC - Behaviour of Reinforced concrete element under low velocity impact loading.</p>	
Reference Books	<ol style="list-style-type: none"> 1. S. U. Pillai & D. Menon, Reinforced Concrete Design, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003. 2. A. K. Jain, Reinforced Concrete Limit State Design, Nem Chand & Bras, Roorkee, 2002. 3. P. C. Varghese, Advanced Reinforced Concrete Design, Prentice -Hall of India Pvt. Ltd., New Delhi, 2001. 4. A. S. Arya & Ajmani, Design of Steel Structures, 1989. 5. J. D. Holmes, Wind Loading of Structures, CRC Press, 2007. 6. N. Subramanian, Design of Steel Structures, Oxford University, 2011. 7. D. Dubina, V. Ungureanu & R. Landolfo, Design of Cold formed Steel Structures, Wiley VCH, 2012. 	
Faculty	A.K. Mittal, Ajay Chaurasia, Siddharth Behera and Micky Dalbehera	

ENG-CBRI-1-1104 Disaster Resistant Building System - I		L-T-P-C 3-0-0-3
Syllabus	<p>Earthquake Resistant Foundation System: earthquake induced foundations failure, Propagation of elastic waves in soils, waves in layered and saturated soils, Dynamic properties of soils and its evaluation, Liquefaction hazard and remedial measures, Seismic bearing capacity of shallow foundations: design requirements, seismic settlement, Seismic analysis of pile foundation under vertical and lateral vibration, Theory of pile failure in seismic liquefaction, Method of analysis, Codal provision, Case studies, Introduction to earthquake resistant building.</p> <p>Fire safety system in buildings: Fundamentals of fire, Fire Growth, Stages of fire development, Spread of fire, Reaction to fire characteristics: Combustibility, Ignitability, Surface spread of flame, Smoke generation etc., Fire retardancy, Fire severity & Controlling factors, Fire resistance of building elements: Heating conditions, Performance criteria for load bearing capacity, integrity, thermal insulation, Smoke movement and control, Fire dynamics and modelling, Fire detection, Fire extinguishment.</p>	
Reference Books	<ol style="list-style-type: none"> 1. S. Bhattacharya, Design of foundation in seismic areas: Principles and some applications, Published by NICEE [National Centre for Earthquake Engineering (India)], , 2007. 2. R. W. Day, Geotechnical Earthquake Engineering, Handbook, McGraw - Hill, New York, 2002. 3. G. Madabhushi, J. Knappett & S. Haigh, Design of Pile Foundations in Liquefiable Soils, Imperial College Press, London, 2010. 4. S. Prakash, Soil dynamics, McGraw Hill, New York, 1981. 5. S. L. Kramer, Geotechnical Earthquake Engineering, Prentice Hall, New Delhi, 1996. 6. D. D. Drysdale, Introduction to Fire Dynamics, 2011. 	
Faculty	Suvir Singh, Shorab Jain, Piyush Mohanty and Anindya Pain	

Elective Courses

ENG-CBRI-1-1120 Concrete Technology		L-T-P-C 3-0-0-3
Syllabus	Developments of concrete, Concrete mix proportioning: Principles and methods, Concrete manufacturing and its placement, Ready mixed concrete, Concrete with admixtures, Rheological properties, Short and long term engineering properties, Microstructural evolutions, Statistical analysis of results, High strength and high performance concretes: Proportioning, Behavior, Applications and Codal aspects, Concrete at elevated temperatures and under cryogenic conditions, Durability of concrete under various exposure condition, Alkali-silica reactions, Corrosion of steel in concrete, Protective measures High volume fly ash concrete, Fibre reinforced concrete, Self compacting concrete, Pervious concrete, Geo-polymer concrete, Recycled aggregate concrete, Light weight aggregate concrete, Sustainable & durable construction, Quality control and quality assurance during production/construction.	
Reference Books	<ol style="list-style-type: none"> 1. A. M. Neville, Properties of concrete, John Wiley & Sons Inc, 5th Edition, 2012. 2. P. K. Mehta & P. J. M. Monteiro, Concrete: Microstructure, properties and Materials, McGraw- Hill, 2005. 3. A. M. Neville & J. J. Brooks, Concrete Technology, 4th Impression, Pearsons Education Ltd, 2009. 4. J. P. Broomfield, Corrosion of steel in concrete: Understanding, investigation and repair, Taylor Francis, London, UK, 2007. 	
Faculty	S.K. Singh & S.R. Karade	

ENG-CBRI- 1-1124 Industrialized Building Systems		L-T-P-C 3-0-0-3
Syllabus	Classification of prefabricated and industrialized building systems, Advantages and disadvantages of IBS, Industrialization for sustainable construction; Modular Coordination, standardization, rationalization, systematization and codal provisions. Building Systems: criteria of selection, sub structural systems, horizontal, vertical, open and closed systems. Strategies for Industrialization: user-friendly building components, production strategies and emerging concepts of prefabrication, generic forms of construction, facade technologies and jointing techniques, Case studies.	
Reference Books	<ol style="list-style-type: none"> 1. F. S. Merritt & J. Ambrose, Building Engineering and Systems Design, Van Nostrand Reinhold, New York, 1990. 2. A. S. G. Bruggeling & G. F. Huyghe, Prefabrication with Concrete, A A Balkema, 1991. 3. F. (Eph.) BUUGER, Design of Precast Concrete Structures, John Wiley & Sons, 1988. 4. K. S. Elliott, Multi Storey Precast Concrete Framed Structures, Blackwell Science Ltd, 1996. 5. Prestressed Concrete Institute (PCI), Chicago, Manual on Design and Typical Details of Connections for Precast and Prestressed Concrete, second edition, (1988). 6. National Building Code - 2005. 7. IS Codes on Modular Coordination. 	
Faculty	Ashok Kumar & Ajay Chaurasia	

ENG-CBRI- 1-1126 Repair, Rehabilitation & Retrofitting of Structures		L-T-P-C 3-0-0-3
Syllabus	<p>Condition Assessment: Appraisal of structures, Types of distresses- causes & effects, Distress diagnosis, Irregularities & inconsistencies in construction, In-place strength assessment, Evaluation of buildings based on demand-capacity method.</p> <p>Innovative Repair Materials: Selection criteria, salient properties, Testing & evaluation of repair materials & systems.</p> <p>Rehabilitation and strengthening techniques: Strategies, Philosophy and design of strengthening, Surface preparation, Grouting, Sprayed concrete, Steel jacketing, Micro-concreting, FRP wrapping etc., Introduction to performance based strengthening strategies, Seismic retrofitting.</p> <p>Codal provisions, Quality Assurance and Control, Case studies of buildings and heritage structures</p>	
Reference Books	<ol style="list-style-type: none"> 1. H.V.S. GangaRao, Navendra Taly & P.V. Vijay "Reinforced Concrete Design with FRP composites", 1st edition, 2007, CRC Press, Tylor & Francis group, USA. 2. A. Chakrabarti, D. Menon & A Sengupta, "Hand book on Retrofitting of Structures-Principles & Applications, 1st edition, 2010, Narosa Publishing House, New Delhi 3. J.H. Bungey, S. G. Millard & M. G. Grantham, Testing of concrete in Structures, 4th edition, Taylor & Francis, London & New York, 2006. 4. Gajanan M. Sabnis, Avanti C. Shroff & Lawrence F. Kahn "Seismic Rehabilitation of Concrete Structure", 1996, SP-160, American Concrete Institute, Michigan, USA. 5. "Repair and strengthening of concrete structure", FIP, Thomas Telford, London 6. R.Holland "Appraisal & Repair of Reinforced Concrete", The Gromwell Press, Thomas Telford Ltd., London 7. Nader Ghafoori "Innovation in Repair Techniques in Concrete Structures", ASCE publication. 	
Faculty	S.K. Singh & Ajay Chaurasia	

ENG- CBRI- 1-1128 Environmental Impact Assessment		L-T-P-C 3-0-0-3
Syllabus	<p>Introduction, Sustainable development, Environmental impact of infrastructural projects, Planning and Management of impacts studies.</p> <p>Impact assessment of infrastructural development on air, surface & sub-surface water, soil, noise, etc., Assessment methods and techniques, Prediction technique for quality of environment attributes. Control measures, Preparation of environmental management plan: carrying capacity and assimilation capacity studies for sustainable development</p> <p>Environmental quality standards: Regulations, Legislations, Environmental Clearance Process, Salient features of EIA notification. Case studies.</p>	
Reference Books	<ol style="list-style-type: none"> 1. David C.Wooten & J.G.Ran Environmental Impact Analysis Hand Books Pub. McGraw – Hill (1979). 2. Canter L.W., Environmental Impact Assessment, McGraw-Hill, 1997 3. Betty Bowers Marriott, Environmental Impact Assessment A Practical Guide McGraw-Hill Professional, 1997 4. Peter Morris & Riki Therivel, Methods of Environmental Impact Assessment, Routledge, 2001. 5. Denver Tolliver, Highway Impact Assessment, Greenwood Publishing Group, 1993 6. R.K.Jain, L.V.G.S. Stacey, H.E. Balbach, Environmental Assessment McGraw-Hill Professional, 2001. 7. Relevant IRC & CPCB Code of Practices / Guidelines 8. CPCB (2006) Pollution Control Acts, Rules and Notifications issued there under Pollution Control Law Series' PCLS/02/2006 Central Pollution Control Board, Delhi. 	
Faculty	A.K. Minocha & Ibrahim Sohel	

ENG- CBRI- 1-1130 Sustainable Design and Energy Efficient Building Systems		L-T-P-C 3-0-0-3
Syllabus	<p>Introduction to sustainable and energy efficient building systems, Sustainable design principles, Low carbon building technologies, Climate factors for buildings design, Thermal comfort and insulation, Passive energy building design, Green building rating systems, Energy Conservation Building Code, Application of performance assessment tools, Low energy building materials, Heat repellent, Insulating materials, Heat transfer through building elements.</p> <p>Case Studies: Integrated design process, Green design projects.</p>	
Reference Books	<ol style="list-style-type: none"> 1. Godfrey Boyle, Renewable Energy, Oxford University Press, 2004, Reprint 2010. 2. Sharma I C, The Climatic Data Handbook, Tata Mc Graw Hill Pub. Co. Ltd., 1993. 3. Givoni B, Man Climate & Architecture, Elsevier, 1969 4. Arvind Krishnan & et al., Climate Responsive Architecture – A Design Handbook for Energy Efficient Buildings, Tata Mc Graw Hill Pub. Co. Ltd. 5. Gupta C P, Prakesh Rajendra, Engineering Heat Transfer, Nem Chand & Brothers -Roorkee, 1979 	
Faculty	Ashok Kumar & B.M. Suman	

ENG-CBRI- 1-1132 Construction, Planning & Management		L-T-P-C 3-0-0-3
Syllabus	<p>Introduction to Building Projects, Modes of public: private participation, Innovative approaches for fiscal mobilization and financing. Project formulation, appraisal & evaluation, Feasibility studies and preparation of detailed project reports (DPRs). Planning - Fundamentals for construction planning, project life cycle. Project Management Issues: planning, monitoring, scheduling, application of Information technology tools, project proposal, project completion, compliance and closure. Tender documents & selection process, contract correspondence, formulation of claims, variations & extensions, dispute resolution, reconciliation and arbitration. Case studies: Urban housing and other building projects.</p> <p>Construction project management: Network scheduling, critical path method (CPM), project evaluation and review technique (PERT), planning and scheduling of activity network, cost - time trade off, linear programming, PERT / Cost accounting. Scheduling with limited resources, resource planning, resource allocation, project schedule compression, generalized activity network.</p> <p>Estimation of project cost, earned value analysis, monitoring project progress, project appraisal and selection, recent trends in project management.</p>	
Reference Books	<ol style="list-style-type: none"> 1. R. Barry, The Construction of Buildings: Parts 1-4, Orient Longman lid. 2. H. Roy & B. Sengupta, Construction Management. 3. A. B. Badiru, STEP Project Management: Guide for science, technology and engineering projects, CPC press, Taylor and Francis Group, USA, 2009. 4. World Bank, Procurement documents related infrastructure projects, www.worldbank.org. 	
Faculty	Ashok Kumar	

ENG- CBRI- 1-1134		Fire Protection Engineering	L-T-P-C 3-0-0-3
Syllabus	Introduction to fire safety engineering, Heat transfer mechanisms in fire and built up of untenability conditions, Flames / fire plumes, Burning behavior of materials, Active fire protection: Portable fire extinguishers, Water mist fire extinguishment system, Fire hydrant and hose reel systems, Automatic sprinkler system, Fixed fire suppression flooding system, Detection and automatic alarm system, Passive fire protection: Structural fire protection, Compartmentation of building' & fire spread, Containment of fire spread, Regulations of fire safety measures and techniques, Case studies.		
Reference Books	<ol style="list-style-type: none"> 1. J. W. Lyone, The chemistry & uses of fire retardants, Wiley Inter science, 1970. 2. T. H. Harmathy, Fire Resistant Designs. 3. J. L. Bryan & Macmillan, Fire Suppression & Detection System, 1993. 4. G. Cox, Combustion Fundamentals of Fire, Academic Press, 1995. 5. D. D. Drysdale, Introduction to Fire Dynamics, Wiley Publications, 2011. 6. C. A. Wilkie & A. B. Morgan, Fire retardency of polymeric materials, CRC Press, Taylor & Francis Groups, Boca Raton, USA, 2010. 		
Faculty	Suvir Singh, RS Chimote and Rajiv Kumar		

ENG- CBRI- 1-1136		Environmental Engineering & Management	L-T-P-C 3-0-0-3
Syllabus	<p>Water and wastewater: Quality Parameters and Standards, Wastewater treatment plant: Industrial wastewater: characteristics, treatment levels and available technologies, Reactor Tanks: Mixed Tanks, Plug Flow, Dispersed Flow, Tanks-In-Series, Residence Time Distribution, Sedimentation-Flocculation, Filtration, Chemical Treatment, Biological treatment, Activated Sludge Treatment, Sanitation infrastructures: sanitation and hygiene-related diseases, Decentralized & Centralized household water treatment</p> <p>Air Quality and Modelling: Sources and classification of air pollutants, indoor and outdoor air pollutants, Characteristics of various air pollutant particulates, Meteorology: influence of solar radiation and wind fields, lapse rate and stability conditions, characteristics of stack plumes, Dispersion and deposition modeling of atmospheric pollutants: Eddy and Gaussian diffusion models, techniques, health and nuisance/aesthetic, Monitoring, Control of particulates: collection mechanisms and efficiencies</p>		
Reference Books	<ol style="list-style-type: none"> 1. H. S. Peavy & D. R. Rowe, Environmental Engineering, McGraw Hill, 1985. 2. S. K. Garg, Environmental Engineering, Khanna Publishers, 2005. 3. Metcalf & Eddy, Wastewater engineering, treatment, disposal and reuse, McGraw Hill, 1979. 4. A. C. Stern, Air Pollution, Vol I to VIII, Academic Press, 1986. 5. M. N. Rao & H. V. N. Rao, Air pollution, Tata McGraw hill, 1989. 6. A. D. Bhide & B. B. Sudresan, Solid waste management in developing countries, New Delhi: Indian National Scientific Documentation Centre, 1983. 		
Faculty	Ibrahim Sohel & Soumitra Maiti		

ENG-CBRI- 2-1102		Advanced Seismology	L-T-P-C 3-0-0-3
Syllabus	<p>Science of Earthquakes, Types and causes, Earthquake Parameters, Seismic Waves, Magnitude & Intensity, Earthquake Source Mechanism, Seismic Instrumentation, Seismicity & Seismic Zoning Map, Indian Earthquake Scenario, Strong Motion Seismology, Strong Motion</p> <p>Parameters, Site Response Studies, Seismic Attenuation, Source and Path effect, Seismic Hazard Analysis, Seismic Risk and its estimation, Post earthquake Investigations, Seismic Micro-zonation, Earthquake Prediction Studies, Seismic Alert Systems</p>		
Reference Books	<ol style="list-style-type: none"> 1. P. N. Agrawal, Engineering Seismology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1993. 2. B. A. Bolt, Earthquakes, W.H. Freeman & Company, ISBN - 978-0716722366, 2003. 3. K. Aki & P. G. Richards, Quantitative Seismology; Theory & Methods, W.H. Freeman & Company, San Francisco, Vol. 1 & 2, 2009. 4. I. Towhata, Geotechnical Earthquake Engineering, Springer Berlin Heidelberg, ISBN-978-3-540-35782-7, 2008. 		
Faculty	P K S Chauhan & Abha Mittal		

ENG- CBRI- 1-1140		Ground Improvement Techniques	L-T-P-C 3-0-0-3
Syllabus	<p>Soft, expansive, loose cohesion less & organic soils, need of ground improvement, engineering properties, principles of treatments, Improvement techniques: preloading, vertical drain, stone column, compaction, chemical stabilization, ground freezing, electro osmosis, blasting, vibrofloatation, clay mineralogy of expansive soil, determination of swell pressure, consequence of swelling, improvement of expansive soils, foundation techniques on expansive soil, soil reinforcement theory, type of soil reinforcements, mechanism of reinforced soil, Soil- reinforcement interactions, different types of soil reinforcements, application of reinforced soil, soil nailing, soil anchors, design of reinforced earth wall, reinforced soil for foundation, quality control in expansive soil, Contaminated soil: effect of contamination, contamination transportation, detection of polluted zone, remediation. Case studies.</p>		
Reference Books	<ol style="list-style-type: none"> 1. P. P. Raj, Ground Improvement Techniques, Laxmi publication (p) Ltd., New Delhi, 2005. 2. R. K. Katti, Behavior of Saturated Expansive Soil & Control Methods, A.A. Balkema publishers, 2002. 3. M. P. Moseley & K. Krisch, Ground Improvement, Spon Press, Taylor and Francis Group, 1992. 4. E. W. Brand & R. P. Brenner, Soft Clay Engineering, Elsevier Scientific Publishing Company, 1981. 5. K. Terzaghi, R. B. Peck & Mesri, Soil Mechanics in Engineering Practices, A Wiley Inter science Publication, 1996. 		
Faculty	Pradeep Kumar, Manojit Samanta and Piyush Mohanty		

ENG- CBRI- 1-1142 Optimization Techniques		L-T-P-C 3-0-0-3
Syllabus	Different types of optimization problems, General form of linear programming problem graphical solution - Canonical form of LPP, Simplex method, basic feasible solution, Big M method, degeneracy, revised Simplex Method - Duality in linear programming, application of duality theory, post optimality or sensitivity analysis - Lagrangian function and saddle point, Kuhn Tucker conditions, primal and dual problem - Integer LPP, cutting plane method, branch and bound method, integer non-linear programming - Pseudo-random numbers, random variables, Univariate and Multivariate analysis, Regression analysis, Poisson, Gaussain and point process, uses of simulations - Introduction to neural network and genetic algorithm etc. - Stochastic Programming	
Reference Books	<ol style="list-style-type: none"> 1. H. Gupta, Operations Research, S. Chand & Company, 1987. 2. C. Mohan & K. Deep, Optimization Technique, New Age International, 2009. 3. J. K. Sharma, Operation Research -Theory and Applications, Mcmillan Publishers India, 2008. 4. H. A. Taha, Operations Research, PHI, New Delhi, 2010. 5. S. S. Rao, Optimization Techniques, New Age International, New Delhi, 1996. 6. Gillett, Introduction to operations Research, McGraw Hill, New Delhi, 1979. 7. M. P. Mccord, Methods of Operational Research, Dover Pub., 2003. 8. D. P. Heymar& J.S. Methew, Stochastic Optimization, Dover Pub., 2004. 	
Faculty	Abha Mittal & PK Yadav	

ENG- CBRI- 1-1144 Deep Excavation		L-T-P-C 3-0-0-3
Syllabus	<p>Introduction to the analysis and design of excavation, Excavation methods and lateral supporting systems: retaining walls, strutting systems, factors influencing on the selection of the retaining strut system, case history. Lateral earth pressure: Rankine's and Coulomb's earth pressure theory, earth pressure for design of excavation. Stability analysis: free and fixed earth support method, shear failure of strutted walls, push in, basal heave, upheaval, sand boiling.</p> <p>Stress and deformation analysis of excavation: simplified method, beam on elastic foundation method, finite element method. Design of excavation supporting systems: design methods and factor of safety, structural components in braced excavations, strut systems, anchor systems, tests of anchors.</p>	
Reference Books	<ol style="list-style-type: none"> 1. Y. O. Chang, Deep Excavation Theory and Practice, Taylor & Francis Group, London, UK, 2006. 2. R. D. Holtz & W. D. Kovaces, An Introduction to Geotechnical Engineering, Prentice - Hall, Inc., Englewood Cliffs, NJ, 1981. 3. Soil Mechanics in Engineering Practice, John Wiley & Sons, New York, 1967. 4. R. B. Peck, W. E. Hanson & T. H. Thornburn, Foundation Engineering, John Wiley & Sons, New York, 1977. 5. M. R. Hausman, Engineering Principles of Ground Modification, McGraw - Hill Publishing Company, New York, 1990. 6. J. E. Bowles, Foundation Analysis and Design, 4th Ed., McGraw - Hill Book Company, New York, USA, 1988. 	
Faculty	Manojit Samanta	

ENG-CBRI-2-1104 Health Monitoring of Building Structures		L-T-P-C 3-0-0-3
Syllabus	Introduction to health monitoring systems of buildings, Use of sensors, Data acquisition techniques, Data Processing, Fast Fourier Transform and Inverse Fourier transform, Diagnostic techniques, Damage detection techniques - Modal curvature, Cumulative Damage Factor, Wavelet Transform, Wireless sensor network, Numerical modeling, Rehabilitation techniques, Case histories.	
Reference Books	<ol style="list-style-type: none"> 1. V. Giurgiutiu, Structural health monitoring with piezoelectric wafer active sensors, Elsevier publications, 2008. 2. D. E. Adams, Health monitoring of structural materials and components, Wiley, 2007. 3. F. Kuochang, Structural health monitoring from system interpretation to autonomous systems, Technomic publication, 2000. 	
Faculty	Ajay Chaurasia and SK. Paingrahi	

ENG-CBRI-2-1106 Tall Buildings & Structures		L-T-P-C 3-0-0-3
Syllabus	<p>Introduction to Tall building systems, Analysis Methodology of tall building frames, Different types of loads, Lateral load analysis, multi bay frames; Shear walls, types, analysis, Coupled frames, Frame with shear wall; Principles of 3-D analysis of tall buildings; Perforated cores, types, Analysis ,Pure torsion, bending and warping of cores; Floor systems: Analysis; Elastic and inelastic stability of frames and shear walls; Analysis for Thermal Stresses; Other Tall structures.</p> <p>Creep & Shrinkage effects on tall buildings, P - Delta analysis.</p>	
Reference Books	<ol style="list-style-type: none"> 1. Daniel Schodek & Martin Bechthold, Structures, Prentice Hall; 7 edition, 2013 2. B. S. Taranath, Tall Buildings - Steel, Concrete, and Composite Design of Tall Buildings, TMH publications, 1997. 3. S.N. Manohar, Tall Chimneys: Design and Construction, Tata McGraw-Hill Pub. Co. 1985 4. Timoshangeo & Gere, Theory of Elastic Stability, TMH publications, 1961. 5. B. S. Smith & A. Coull, Tall Building Structure, Analysis & Design, John Wiley & Sons, 1991. 6. M. Fintal, Handbook of Concrete Structures, CBS Publishers & Distributors, 2004. 7. Advances in Tall Buildings, CBS Publisher & Distributors, Delhi, 1986. 	
Faculty	A.K. Mittal & Siddharth Behera	

ENG-CBRI- 2-1108 Behaviour of Metal Structures		L-T-P-C 3-0-0-3
Syllabus	<p>Introduction - Stability of frames, plates - Lateral buckling of beam - Compression Members - Combined bending and axial-combined bending & torsion; Buckling of thin elements - Torsional buckling of thin walled structures and open sections - Column - Strength curves - Buckling and post-buckling strength of plate elements with special reference to Codal provisions - Behaviour of light gauge steel structures; Prestressing in steel structures, Types of Connections- Welded, Bolted, Screwed, Rupture Failure of Connections. Introduction to Impact in metal structures- Behaviour of materials (steel, CFST) subjected to low velocity impact.</p>	
Reference Books	<ol style="list-style-type: none"> 1. C. G. Salmon, J. E. Johnson & F. A. Malhas, Behaviour of Steel Structures, Prentice Hall,, 2008. 2. S. P. Timoshenko & J. M. Gere, Theory of Elastic Stability, Dover Publications, 2009. 3. A. Kumar, Elastic Stability. 4. Yu, Design of Light gauge Structures. 5. K. Mukhanov, Design of Metal Structures, University Press of the Pacific, 2002. 6. D.E. Blodgeth, Design of Welded Structures, The James F. Lincoln Arc Welding Foundation, 1996. 7. D. Dubina, V. Ungureanu & R. Landolfo, Design of Cold-Formed Steel Structures, Pub: European Convention for Constructional Steelwork, 2013. 8. W.W. Yu & R. A. LaBoube, Cold-formed Steel Design, Wiley Publishers, 2010. 	
Faculty	A.K. Mittal, Siddharth Behera and Mickey Dalbehera	

PHY/ENG- CBRI- 1-1138		Rock Mechanics	L-T-P-C 3-0-0-3
Syllabus	<p>Rocks, rock structures and their importance: Rocks (Igneous, sedimentary, metamorphic) & rock masses; Joints & discontinuities; Folds & faults; Effect of discontinuities on stability using stereographic approach. Surface and subsurface investigations: Geological and geophysical investigations, Engineering rock mass classifications and their application:</p> <p>Terzaghi's rock load concept; RMR; Q; GSI. Physico-mechanical properties of rocks: Important physico-mechanical properties; Effect of temperature on rock strength. Dynamic properties. Stresses in elastic and plastic ground conditions: In situ stresses; Induced stresses after excavation; Stress variation around horizontal circular opening in elastic and plastic ground conditions. Excavation Methods: Drill & blast methods for surface and underground; Tunnel boring machine (TBM). Support design and instrumentation in tunnels: Analytical and empirical approaches in brief; GRC and SRC; NATM; Support types; Design considerations under dynamic conditions; Instrumentation.</p> <p>Problems and their remedies in rock engineering: Stress problems (Squeezing and rock-burst); Swelling and water pressure. Application of rock mechanics: Traffic tunnels; Hydro-electric tunnels; Building/ dam foundations on rock; Underground civic facilities; Underground defence shelters, storage of petroleum and nuclear waste repository etc.</p>		
Reference Books	<ol style="list-style-type: none"> 1. B. Singh & R. K. Goel, Engineering Rock Mass Classification - Tunneling, Foundations and Landslides, Elsevier Science Ltd., U.K., 2011. 2. B. Singh & R. K. Goel, Software for Engineering Control of Landslide and Tunnelling Hazards, Balkema/ Swets & Zeitlinger, Netherlands, CRC press, 2002. 3. J. C. Jaeger, N. G. W. Cook & R. W. Zimmerman, Fundamentals of Rock Mechanics, Fourth Edition, Blackwell Publishing, USA, 2007. 4. B. P. Verma, Rock Mechanics for Engineers, Khanna Publishers, Delhi. 5. T. Ramamurthy, Engineering in Rocks for Slopes, Foundations and Tunnels, PHI Learning Pvt. Ltd., New Delhi, 2010. 		
Faculty	R.K. Goel R.D. Dwivedi		

PHY/ENG-CBRI-2-1110		Landslide Disaster Mitigation	L-T-P-C 3-0-0-3
Syllabus	<p>Introduction; Landslide Types and processes; Landslide Causes; Application of Remote Sensing and GIS in Landslide studies: Spatial data acquisition and operations, Digital Elevation Modeling & Surface analysis, Thematic mapping, Spatial analysis; Landslide Hazard and Risk Assessment: Concept & Techniques, Case Studies; Landslide Investigations: Geological, geophysical & geotechnical; Landslide Instrumentation: Surface & sub-surface monitoring; Slope Stability Analysis: Rock & soil slopes, SMR & Slope Stability Assessment; Landslide control measures: Types & design</p>		
Reference Books	<ol style="list-style-type: none"> 1. Sassa, Landslides - Risk Analysis and Sustainable Disaster Management, Springer Publishers, 2005. 2. Turner & Schuster, Landslides - Investigation and Mitigation, 1996. 3. Hoek & Bray, Rock Slope Engineering. 4. R. Chowdhury, P. Flentje & G. Bhattacharya, Geotechnical Slope Analysis, Taylor & Francis, 2009. 5. P. A. Burrough & R. A. McDonnell, Principles of Geographic Information System, Oxford University Press, 2006. 6. C. P. Lo & A. K. W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2002. 		
Faculty	S. Sarkar & D.P. Kanungo		

ENG-CBRI- 1-1106		Laboratory - II	L-T-P-C
		Structural Engineering & Fire Engineering	0-0-4-2
Syllabus	<p>Structural Engineering: Characterisation of raw materials of concrete, Concrete mix proportioning of grade M30 & M60, casting & testing of cubes, cylinders and prisms, non-destructive tests such as rebound hammer, ultrasonic pulse velocity, rebar locator, impact echo, corrosion tests, vibration monitoring etc; casting and testing of reinforced concrete beams under static & dynamic loading conditions, testing of FRP strengthened beams.</p> <p>Fire Engineering: Fire propagation index, Surface spread of flame test, Ignitability test at various irradiances levels, Non-combustibility test, Specific optical density of smoke, Toxicity index, Limiting oxygen index test, Cone calorimeter test: Rate of burning of polymeric building materials.</p>		
Faculty	S.K. Singh, Harpal Singh and Subash Gurram		

Core Courses**SEMESTER III**

ENG-CBRI- 1-1115		Disaster Resistant Building System II	L-T-P-C 3-0-0-3
Syllabus	<p>Landslide Disaster Mitigation: Introduction, Landslide nomenclature & processes, Inherent & external processes for landslide phenomena, Landslide susceptibility & vulnerability assessment, Geo-investigation & failure mechanism, Real time landslide monitoring for early warning system, Landslide control measures: types & design.</p> <p>Earthquake resistant building structure: Characteristics of earthquakes, analysis of structures for earthquake loading, Linear Analysis, Codal Method, Dynamic analysis of RC structures, codal method and comparison with Eurocode 8, Earthquake resistant design of reinforced brick masonry, Ductility and detailing of RC members, Demand Capacity Ratio Method; Non-linear Pushover Analysis, Rapid visual screening and seismic evaluation of buildings, Strengthening of existing buildings:RC, Steel and Introduction to Performance based Engineering Strategies.</p> <p>Introduction to Tsunami Disaster.</p>		
Reference Books	<ol style="list-style-type: none">1. Sassa, Landslides - Risk Analysis and Sustainable Disaster Management, Springer Publishers, 2005.2. Turner and Schuster, Landslides - Investigation and Mitigation, 1996.3. Hoek & Bray, Rock Slope Engineering.4. R. Chowdhury, P. Flentje & G. Bhattacharya, Geotechnical Slope Analysis, Taylor & Francis, 2009.5. K. Chopra, Dynamics of Structures: Theory and application to Earthquake Engineering, Prentice Hall, 2001.6. T. Pauley & M. J. N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons Inc. New York, Australia, 1992.7. D. J. Dowrick, Earthquake Risk Reduction, John Wiley & Sons Limited, 2003.8. ACI 440.2R-08, Guide for the design & construction of externally bonded FRP systems for Strengthening of Concrete Structures.9. Seismic evaluation of retrofit of concrete buildings, ATC-40.		
Faculty	S. Sarkar, D.P. Kanungo, A.K. Mittal and Siddharth Behera		

List of Faculty

Faculty name	Email
A.K. Minocha	minochaak@yahoo.com
A.K. Mittal	achal_cbri@rediffmail.com
Abha Mittal	abham2003@yahoo.com
Ajay Chaurasia	ajaycbri@gmail.com
Anindya Pain	pain_anindya@yahoo.co.in
Ashok Kumar	kumarcbri@rediffmail.com
B. Singh	singhb122000@yahoo.com
B.M. suman	bs_ashishh@rediffmail.com
D.P. Kanungo	debi.kanungo@gmail.com
Harpal Singh	harpal@cbri.res.in
Ibrahim Sohel	ibrahim.sohel@gmail.com
L.P. Singh	lpsingh@cbri.in
Manojit Samanta	manojit_samanta@rediffmail.com
Micky Dalbehra	mickey2049@gmail.com
P K S Chauhan	pradeepali@yahoo.com
P.C. Thapliyal	pc.thapliyal@gmail.com
P.K. Yadav	prd_yadav@rediffmail.com
Piyush Mohanty	pyushmohanty@gmail.com
Pradeep Kumar	pkkiran2002@yahoo.com
R.K. Goel	rkgoel15@gmail.com
R.S. Chimote	ratnakar1961@yahoo.com
Rajiv Kumar	rajivkgoel@gmail.com
Rajni Lakhani	rlakhani_cbri@rediffmail.com
S. Sarkar	shantanu_cbri@yahoo.co.in
S.K. Panigrahi	panigrahi1111@yahoo.com
S.K. Singh	sksingh_cbri@yahoo.co.in
S.R. Karade	srkarade@cbri.res.in
Shorab Jain	shorab122@gmail.com
Siddarth Behra	siddharthcbri@gmail.com
Soumitra Maiti	soumitra.maiti@gmail.com
Subhash Gurram	subash.gb@gmail.com
Suvir Singh	suvir_singh@yahoo.com

PhD programme : for details of the PhD programme, refer to the PhD brochure
(website: www.cbri.res.in)

For further information or clarification please contact:

Director
CSIR-Central Building Research Institute
Roorkee, Uttarakhand- 247667
e-mail: director@cbri.res.in
Phone: (01332) 283323
Fax: (01332) 272272

Dr S.R. Karade
Co-ordinator, AcSIR
CSIR-Central Building Research Institute
Roorkee, Uttarakhand, 247 667
e-mail: coordinator.cbri@acsir.res.in
srkarade@cbri.res.in
Phone:(01332) 283463
Fax: (01332) 272272