Structure of Post Graduate
(M.E. Infrastructure Engineering)

THAPAR INSTITUTE OF ENGINEERING & TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
PATIALA, PUNJAB, INDIA
CURRICULUM & SCHEME OF COURSES

ME-Infrastructure Engineering

Civil Engineering Department

2017
Curriculum Development – Guiding Principles

The statutory bodies of the University, the Senate or the Planning and Monitoring Board oversee the design and development process so that the activity is carried out in a planned manner. The detailed planning for this activity is the responsibility of the Department Head. The systematic process of design and development includes the activities & sub activities including techniques & organizational interfaces and the time frame for completion of various activities. The plans are updated, as the instructional design evolves.

The design and development process generally begins with a need analysis report which comprises of (i) Stated needs (ii) Implied needs (iii) Overall goals of instructions (iv) Relevant standards i.e. AICTE and UGC guidelines and Curricula of Entrance Tests like Indian Engineering Services (IES) and Graduate Aptitude Test for Engineers (GATE), etc. and (v) General characteristics of target population.

Organizational and Technical interfaces between different faculty and external expert groups providing input to the instructional design are defined, committees are constituted and their reports are documented. Faculty members from different disciplines connected with the design & development activity are associated with the process. The updation/restructuring is carried out as the design process progresses. Clear responsibilities are assigned and effective communication is ensured.

The requirements of instructional design are determined and recorded. For instructional design, the input is taken from various sources. Input requirements are clearly understood and reconciled. The design input may come from:

- Need analysis & Reviews.
- Recommendations from
  - Faculty & senior management
  - Employers and industry
  - Alumni
  - Regulatory Bodies
- Success/failure reports of similar courses & programs.
- Published literature relevant to programs.
- Boundary condition w.r.t GATE, IES, IAS curricula etc.

The general steps followed in curriculum development are as under:

- The need for starting a new programme or course(s) may arise from interaction with Industry, Faculty, Students, Alumni or PMB/Senate/BOG, UGC/AICTE etc.
- The idea of proposed programme is discussed in the HODs’ meeting and if found appropriate, the Head of concerned department is asked to put up a proper proposal. A sub-committee of internal/external member(s) may sometimes be formed for making the feasibility and viability analysis.
- The DAAC (on the basis of recommendations of sub-committee, wherever required) does the need analysis and prepares the proposal for approval from Board of Studies (BOS).
The BOS after deliberating on the proposal may make the desired modifications and then send the proposal to DOAA for consideration in SUGC/SPGC, along with the duly filled checklists.

The proposal is put up for consideration to SUGC/SPGC and upon its approval the recommendations may be sent to the Senate and PMB.

After the Senate approval, the proposal may be sent to concerned Department/School through academic section for allocation of appropriate course codes OR if required it is sent to AICTE/UGC for approval and the status is put up in the forthcoming meeting of BOG.

Once approved, it is implemented by the concerned Department/School after allocation of proper course code by the academic section.

The employability, innovation and research in curriculum design and development is ensured by:

- Involvement of industry professionals in curriculum development
- Benchmarking exercises to extract customers (employer’s) requirements
- Mandatory project semester in Industry for all UG and some PG students
- Synergizing curriculum with industry practices and needs

The curriculum design and development for all programs is done at least once every four years to ensure continuing suitability, adequacy and effectiveness in satisfying the requirements and the vision, mission and quality policy of the University. The design process includes assessing opportunities for improvement and the need for ensuring suitable employability, innovation and research (more applicable to postgraduate programs). The process invites formal inputs from all stakeholders and generally includes the following sources:

- Action taken report on the previous reviews and external accreditation reports (NAAC, NBA-AICTE)
- Results of student’s performance in various examinations
- Result of Students Reaction Survey
- Feedback from
  - Industry,
  - Alumni,
  - participating organizations in campus placement and other concerned sources
- Details of corrective/preventive actions
- Improvement programs suggested/recommended
- Training programs launched
- Review of mission and quality policy
The process of determining solutions to satisfy the identified needs is laid down and documented. Instructions are designed by incorporating these solutions. The analysis and mappings are recorded. The design output at this stage is taken as the initial design for subsequent reviews. The output of instructional design & development is documented in the form of a report named “Curriculum and Scheme of Courses”. Through various reviews and verifications, it is ensured that the design output meets the design input requirements.

The design output report includes:

- The types and levels of skill and knowledge to be imparted
- Program Educational Objectives; Student Outcomes
- Course Learning Outcomes
- Scheme of courses and the detailed syllabi
- Assessment and evaluation.

The output documents like curriculum and instructional strategies are reviewed and approved before release at various levels and stages.

Reviews are conducted at defined stages of the curriculum Design, in which faculty members from the concerned area as well as experts from amongst the peer group from within and/or outside the University are associated. Records of the reviews are maintained. Based on the reviews, the curriculum is updated.

New/revised curriculum and instructional design is made applicable to the prospective students. The curriculum is validated in the initial stages of its introduction by taking a feedback from students and faculty members regarding the effectiveness and applicability of the curriculum, with regard to the documented needs. Necessary changes, if required, are made to ensure that the design conforms to defined needs of the students. Wherever required, additional instructional sessions and allied inputs are arranged for students/participants.
Some Broad Guidelines

Post-graduate Programs

MASTER OF ENGINEERING/TECHNOLOGY (M.E./M.Tech.)

The University in offering various M.E./M.Tech. Programmes has uniformly maintained the basic structure and philosophy of the post-graduate education in engineering in the country. All these programmes, regular or part-time, have their course work classified into two major categories: Core Courses and Elective Courses. The core courses are aimed at imparting knowledge of the relevant basics analytical-tools & techniques necessary to build-up on them elective (professional) courses. Core courses of a particular programme are compulsory for all the students registered in that programme. Elective courses are of professional nature. To be eligible for a degree, a student must complete requisite number of core and elective courses. However, to bring in flexibility a wide choice of electives is offered to the students in order to make their training broad based. Presentation of a Seminar and a project in addition to the course work and further carrying out a thesis/dissertation are necessary components of post-graduate degree. The seminar and project should be on a topic relevant to the area of study, presenting the state-of-art work done on the subject. The literature survey conducted during the preparation of the seminar should highlight the areas for further research work on the subject. The problem taken up for the thesis/dissertation should be as far as possible on the work done for the seminar. Both the seminar and thesis/dissertation are submitted in bound form and are presented during their respective evaluation. In case a student fails to undertake, complete & clear thesis work and completes seminar only he will be eligible for award of Post-graduate diploma only.

The Program Scheme and inter-relationships are shown below:
Post Graduate Program (ME- Infrastructure Engineering)

Category

Math and Computing
- PCL105

I Year
- NA

II Year
- NA

Analysis, Design & Construction
- PIN111/PIN313/PIN314/PIN312

Infrastructure Planning & Management
- PIN301/ PIN315

Industrial training, Seminar, Project and Dissertation
- PIN291
Scheme consists of subjects of Transportation Engineering, Hydraulic Engineering, Structural Engineering & Geotechnical Engineering.
COURSES SCHEME & SYLLABUS

M.E. (INFRASTRUCTURE ENGINEERING)
Program Educational Objectives and Program Outcomes
M.E. (Infrastructure Engg.) Program

Program Educational Objectives:

- To impart knowledge to students in the latest technological aspects of Infrastructure projects and to provide them with opportunities in taking up advanced topics of the field of study.
- To prepare the students to excel in post graduate program and to succeed in industry, technical profession through global rigorous education.
- Moulding the graduate civil engineers to undertake safe, economical and sustainable design of infrastructure projects.
- To broaden and deepen their capabilities in experimental research methods, analysis of data, and drawing relevant conclusions for scholarly writing and presentation.
- To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, managerial skills multidisciplinary approach, and an ability to relate engineering issues to broader social context.

Program Outcomes:

At the completion of the M.E. program in Infrastructure Engineering, the student will be able to

- Design, analyze, and evaluate systems in Civil Infrastructure Projects.
- Critically assess the relevant technological issues.
- Conduct experimental and/or analytical work and analyzing results using modern mathematical and scientific methods.
- Formulate relevant research problems and critically assess research of their own and of others.
- Write clearly and effectively for the practical utilization of their work.
### COURSE SCHEME & SYLLABUS FOR M.E. (INFRASTRUCTURE ENGINEERING)

#### SEMESTER – I

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>COURSE NO.</th>
<th>TITLE</th>
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<th>T</th>
<th>P</th>
<th>CR</th>
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<tbody>
<tr>
<td>1.</td>
<td>PIN101/PIN104</td>
<td>DESIGN OF HYDRAULIC STRUCTURES</td>
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#### SEMESTER – II

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<td>7.</td>
<td>PIN291*</td>
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*: in summer vacations

#### SEMESTER – III

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<td>1.</td>
<td>PIN301</td>
<td>MASS TRANSPORTATION SYSTEMS</td>
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91<sup>st</sup> Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
### SEMESTER – IV

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**TOTAL NUMBER OF CREDITS: 76.5**

### ELECTIVES – I

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<th>COURSE NO.</th>
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### ELECTIVES – II

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### ELECTIVES – III

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<td>PIN222</td>
<td>GROUND IMPROVEMENT</td>
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<td>3.</td>
<td>PIN223</td>
<td>DESIGN OF PAVEMENTS</td>
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### ELECTIVES – IV

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<td>1.</td>
<td>PIN311</td>
<td>MECHANICS OF SEDIMENT TRANSPORT</td>
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<td>PIN314</td>
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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PIN101/PIN104: DESIGN OF HYDRAULIC STRUCTURES

<table>
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</table>

**Course Objectives:** To understand the different types of dams and their working principles.

**Introduction:** Types, classification, factors governing the selection of a dam site

**Gravity Dams:** Forces acting on gravity dam, Design, Modes of failure and criteria for structural stability, principal and shear stress, methods of analysis, elementary profile of a gravity dam, high and low gravity dam, Joints in gravity dam, Galleries, foundation treatment

**Earth dam:** Classification, Method of construction, Causes of failure, Design criteria, seepage line and its location, Design of Filters, Seepage control, Stability of earth dams.

**Arch dams:** Types, forces acting on arch dam, design of arch dam

**Buttress dams:** Types, forces acting on buttress dam, design of buttress dam

**Spillways:** Location, types, design consideration, energy dissipation below spillways, design of stilling basin, spillway crest gates

**Assignment/Project:** To design the gravity dams based upon site specific data.

**Course Learning Outcomes (CLO):**
After the completion of this course the students would be able to:
1. Design the various types of dams.
2. Analysis the stability of the existing dams for the loading conditions.
3. Design the appropriate types of spillways.

**Recommended Books:**

**Evaluation Scheme:**

<table>
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<th>Sr. No.</th>
<th>Evaluation Elements</th>
<th>Weightage (%)</th>
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<td>MST</td>
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</tr>
<tr>
<td>2</td>
<td>EST</td>
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<tr>
<td>3</td>
<td>Sessionals (May include assignments/quizzes)</td>
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</table>

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Course Objectives: To understand the concepts of bearing capacity of soil so as to have deeper understanding in the design of foundations

Shallow foundations: Terzaghi’s bearing capacity equation, General bearing capacity equation, Meyerhof’s Vesic theory, Effect of water table, Special footing problems, I.S. Codes, Footing pressure for settlement on sand, Soil pressure at a depth, Boussineq’s and Westergaard’s methods, Computation of settlements, Inclined and Eccentric Loads.

Pile foundations: Timber, Concrete, Steel piles, Estimating pile capacity by dynamic formula, by wave equation and by static methods, Point bearing piles, Pile load tests, Negative skin friction, Modulus of sub-grade reaction for laterally loaded piles, Lateral resistance, Pile group considerations, Efficiency, Stresses on underlying strata, Settlement of pile groups, Pile caps, Batter piles, Approximate and Exact analysis of pile groups, I.S. Codes.

Well Foundations: Types (open end, closed or box, Pneumatic, Drilled), Shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Stability of well foundations by IRC Method, Construction, Tilts & shifts.


Introduction to Geotechnical Earthquake Engineering: Ground Shaking, Liquefaction, Evaluation, Mechanism, Effects of liquefaction.


Assignment / Project: Design of Pile and Well foundations based upon real project site specific data.

Course Learning Outcomes (CLO):
After the completion of this course the students would be able to:
1. Understand the concept of evaluation of bearing capacity for shallow foundations
2. Evaluate the load carrying capacity of pile and well foundations
3. Perform geotechnical analysis of machine foundations
4. Understand the concept of liquefaction of soils
**Recommended Books:**


**Evaluation Scheme:**

<table>
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<tr>
<td>3</td>
<td>Sessionals (May include assignments/quizzes)</td>
<td>25</td>
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</table>
Course Objectives: To understand various concepts of infrastructure planning and management.

An overview of Basic Concepts Related to Infrastructure: Introduction to Infrastructure, an overview of the Power Sector in India, an Overview of the Water Supply and Sanitation Sector in India, an overview of the Road, Rail, Air and Port Transportation Sectors in India, an overview of the Telecommunications Sector in India, an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and Players in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle, an overview of Infrastructure Project Finance


Challenges to Successful Infrastructure Planning and Implementation: Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The Case study for Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.


Assignment/Project: Case study of some successful & sustainable infrastructure projects.

Course Learning Outcomes (CLO):
After the completion of this course the students would be able to
1. Understand the role of private sector in infrastructure growth.
2. Understand the strategies for successful Infrastructure Project implementation.
3. Infrastructure modelling and Life Cycle Analysis Techniques.

Recommended Books:

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)

Evaluation Scheme:

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PIN103: REMOTE SENSING AND GIS

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Course Objectives: To analyze the remote-sensed data for solving geospatial problems.


Sensors and Platforms: Types of sensors, Multispectral, hyper spectral, thermal, orbital characteristics, working principles and instrumentation. Storage and Retrieval of data - IRS and ERS satellite systems – Introduction, Stages of development, Sensory Characteristics, Orbit and Coverage’s, various types of data product and its uses.


Data analysis: Image Interpretation Elements, Keys and Aids. Basic Instrumentation - Visual analysis of data in application of remote sensing to various engineering fields.

Principles of Geographical Information Systems (GIS): Geographic information and spatial data types, Hardware and software; GIS; Steps of spatial data handling, database management systems, Spatial referencing.

Data: Quality, measures of location errors on maps, Satellite-based positioning, Spatial data input, data preparation, Point data transformation.

Analytical GIS capabilities: Retrieval and classification; overlay functions, neighbourhood operations; network analysis; error propagation, Data visualization.

Assignment / Project: Analyses of the remote sensed data for the project.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. To design the various processes involved in remote sensing.
2. To processes the raw data and prepare the final product after necessary corrections.
3. To interpret the remotely sensed data.
4. To learn the use geospatial data for the benefit of the end users.

Recommended Books:

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)

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PCL105: Statistical Methods and Algorithms

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**Course Objective:** To learn, understand and implement different techniques related to probability distributions and statistical models.

**Introduction:** Nature and objectives of research, Study and formulation of research problem. Scope and formulation of hypothesis. Preparation and presentation of research proposal using statistical package.


**Analysis of variance:** One Way Classification: ANOVA for fixed effect model, ANOVA for Random Effect Model, Two-way Classification (one observation per cell): ANOVA for fixed effect model, ANOVA for Random Effect Model.


**Multivariate Data Analysis:** Introduction, multivariate normal distributions, Mean vector, Variance-covariance matrix, Correlation matrix and their estimation for multivariate data. Stepwise regression, Selection of best set of variables, Classification and discrimination problems. Factor analysis and principal component analysis. Illustrative examples and Multivariate data analysis using statistical package.


**Recommended Books**

1. Medhi, J., Stochastic Processes, New Age International
2. Montgomery, Introduction to Statistical Quality Control, John Wiley and Sons
Course Learning Outcomes (CLOs)

CLO1 Basic understanding of probability distributions and statistical data analysis techniques.
CLO2 Know the properties and characteristics of Markov Chain Model
CLO3 Understand data classification techniques using fixed effect and random effect models
CLO4 Understand time series data analysis

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Course Objectives: To understand the different methods of site exploration and soil testing techniques.

Need and importance of site investigations: Site exploration and phasing of site exploration programme, Spacing and depth of bore holes, significant depth

Methods of site exploration: Soundings bore holes, drilling methods and equipment wash boring, rotary boring and percussion boring in soils at stabilization of bore holes. Procuring and handling of disturbed and undisturbed samples- various types of samplers and sampling techniques, their relative merits and suitability in particular cases, lowering of water table.

Geophysical methods of soil exploration: Seismic, electrical and resistivity methods, Magnetic and gravity methods, Observation of ground water level, Different methods of ground water observation, Their merits and demerits.

Soil testing techniques: Field tests for permeability, in place density, vane shear test, plate bearing test, standard penetration test, SCPT, CPT, Pressure meter test.

Laboratory Work: Tri-axial shear test, Drained and Un-drained test, Consolidation test, unconfined compressive strength test, direct shear test. Recording and reporting of data for particular engineering use e.g. for machine foundations, earth dams etc, Discussion and seminar on published papers of recent origin connected with exploration and testing of soils, case histories of failure of structures.

Assignment /Project: Students in groups of 4 to 6 will do the projects by conducting test like SPT, PLT and lab tests, the students will determine the safe bearing capacity for various structures like Multi-storeyed buildings, OHSR etc.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:

1. Plan the site exploration program for the construction of various structures.
2. Procure and handle the testing of disturbed and undisturbed soil samples.
3. Perform various lab tests for prediction of shear strength of soils.
4. Perform and analyse the data from various in-situ soil testing methods.

Recommended Books and Manuals:


91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
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PIN202: TRANSPORTATION PLANNING AND ECONOMICS  

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**Course Objectives:** To understand the concepts in the planning & economics of urban transport systems.

**Hierarchical Level of Planning:** Passenger and Goods Transportation, General Concept and Process, Urban Travel Characteristics, Private & Public Travel Behaviour Analysis Travel Demand Estimation and Forecasting, Trip Generation Methods and their Comparison, Modal Split Analysis, Behavioural Approach, Two stage Modal Split Models


**Network Assignment:** Capacity Restrained and Simultaneous Distribution, Direct Demand Models. Land-use Transport Planning, Transport Related Land use Models. Corridor Type Travel Planning, State wise and Regional Transportation Planning.

**Assignment / Project:** To perform the economical & financial analysis of the infrastructure project.

**Course Learning Outcomes (CLO):**

After the completion of this course the student will be able to:
1. Analyse the travel characteristics for the urban road network.
2. Perform Travel Demand Estimation and Forecasting.
3. Perform State wise and Regional Transportation Planning.

**Recommended Books:**

**Evaluation Scheme:**

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91ˢᵗ Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Course Objectives: To provide an overview on environmental legislation and acts applicable for environmental pollution; to facilitate understanding on role of pollution control boards and their procedure; and to facilitate understanding of various aspects related to EIA processes.

Definition of Terms: Conventions and protocols; Policy; law; acts and rules; Administrative and legal interpretations; Codes and specifications.

Overview of Environmental Legislation: Overview of Indian environmental law; Pollution control boards – Powers; functions and Procedures.

Provisions of Water Act; Water-cess Act; Air Act; Environmental Protection Act; Public Liability Insurance Act as Applicable to Industry: Provisions relating to Environmental clearance; Environmental sampling, analysis and reporting of results; Environmental standards; Overview of other key environmental regulations- Municipal solid waste rules; Biomedical waste rules; Hazardous waste, microorganisms, and chemicals rules;

Legal Aspects of EIA: EIA notification; Environmental clearance process - Screening; scoping; public consultation and appraisal; Objectives and scope of EIA; EIA process flow chart.

Project and the Environment Description: Environmental feasibility analysis; Baseline studies; and environmental data collection: Methods of Impact analysis- checklists; matrices; networks; overlays etc.

EMP (Environmental Management Plan) and EIA Documentation: Principles and Elements of approach; identification and mitigation of environmental impacts: types and structure of EIA documents.

Course Learning Outcomes (CLO):
After the completion of this course the student will be able to:
1. Becoming aware of the environmental legislation, environmental policies of the country and of the international environmental conventions and protocols.
2. Knowing the environmental regulations applicable to the industry and other organizations with significant environmental aspects.
3. Knowing about the environmental requirements applicable to the environmental impact assessment, and about the environmental clearance process of developmental projects.
4. Understanding the methods and tools of identification, prediction and evaluation of environmental impacts of developmental projects.

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Recommended Books:
1. CPCB, Pollution Control Law Series - PCL/2/2001; Central Pollution Control Board (http://envfor.nic.in/cpcb/cpcb.html).

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PCE101: ADVANCED STRUCTURAL ANALYSIS

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**Course Objectives:** To analyze structural engineering systems by various approaches

**Stiffness Method (Systems Approach):** Basis of stiffness method, Degrees of freedom, Force-displacement relationships, Nodal stiffness.

**Flexibility Method (Systems Approach):** Flexibility coefficients, Basis of the method, Application to various types of structures.

**Introduction to Element Approach:** Member stiffness matrix, Local or Member co-ordinate system, Global or Structural co-ordinate system, Rotation of axes etc, Structure stiffness matrix.

**Structural Stability Analysis:** Elastic Instability, Introduction to stability problem, Energy methods, buckling of axially loaded members for different end conditions, Concept of effective length, approximate techniques, Stability analysis of beam-column and frames.

**Plastic Analysis:** Concept of Limit load analysis, Upper and lower bonds, Plastic analysis of beams and multi-storey frames using mechanism method.

**Non Linear Analysis:** Introduction to geometric and material non-linearity.

**Assignment/Project:** Analyse single storey single bay 3D building frame using any software and compare the results obtained manually by using displacement method.

**Course Learning Outcomes (CLO):**

After the completion of this course the student will be able to:

1. Develop the stiffness matrix of the structures and analyze them using displacement methods
2. Develop the flexibility matrix of the structures and analyze them using force methods
3. Perform plastic analysis of various structures
4. Carry out stability analysis of columns and beam-columns for various end conditions

**Text Books:**


91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Reference Books:

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PCE301: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Course Objectives: To design earthquake resistant structures as per IS guidelines

Past Earthquakes: Review of damage in past earthquakes.

Earthquake response of structures, Idealization of structures, Response spectrum analysis, Equivalent lateral force concepts, Torsionally coupled systems, Orthogonal effects, Nonlinear, Pushover and Time history analysis.

Philosophy of earthquake resistant design: Ductility, Redundancy & Over strength, Damping, Base Isolation Supplemental Damping, Codal Provisions.

Seismic behaviour of Structures: Concrete structures, Steel and masonry structures, Material properties, Analysis of members under cyclic loads, Detailing provisions, Concepts of structural control.

Assignment/Project: Compare the various codal recommendations of different countries with Indian standard code for earthquake resistant design of RCC and Masonry structures /Generate code compatible artificial time history acceleration compatible to IS 1893 part I 2002 code with respect to various soil & site conditions.

Course Learning Outcomes (CLO):
After the completion of this course the student will be able to:
  1. Evaluate seismic forces for various structures as per relevant Indian Standards
  2. Design and ductile detailing of structures for seismic resistance as per Indian Standards
  3. Apply concepts of repair and rehabilitation of earthquake affected structures

Text Books:

Reference Books:

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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PCE323: INDUSTRIAL STRUCTURES

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**Course Objectives:** To analyze and design various industrial buildings

**Review of Plastic Design:** Concept of minimum weight design

**Design of Industrial Buildings:** General, Framing, Crane girders & columns, Analysis of trussed bents, Design of industrial frame.

**Design of Storage Structures:** Design of containers like bunkers, silos.

**Design of Space Structures:** Transmission towers, Steel domes, Pre-cast building components.

**Design using Light Gauge Sections:** Structural use of pressed sections and light gauge sections, Aluminium as a material of construction for industrial structures and design of such structures, Tubular structures and Sandwich plate construction.

**Aluminium structures:** Introduction, Permissible stresses, Tension members, Compression members, Design of beams, Local buckling of compression elements, Riveted and bolted construction, Design of chimneys, Load analysis, Design of steel supporting chimney, Chimney foundation

**Construction Practices:** Shop practice in steel construction, Fabrication erection and production.

**Assignment/Project:** To perform detailed analysis and design of a specific industrial building

**Course Learning Outcomes (CLO):** The students will be able to:

1. Carry out plastic design of structural elements
2. Analyze and design industrial buildings and storage structures
3. Analyze and design structures using light gauge steel and aluminium
4. To understand shop practice in steel construction including fabrication, erection and production.

**Text Books:**


**Reference Books:**


91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
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Course Objectives: To perform the analysis of Sheetpiles, Cofferdams & Earthdams.

Sheet Piles and Cofferdams: Types of sheet piles, principal advantages of sheet piles, analysis of cantilever wall in sands, simplified approach in clays ($\phi = 0$) Anchored bulk head stability, Free earth support method, fixed earth support method. Types of cofferdams, relative merits and their advantages as compared to other types, comparison between circular and diaphragm types, failure modes of cells, stability analysis of cofferdams by TVA method. Open cuts, necessity of bracing and strutting in open cuts, pressure distribution diagram under various cases, deep open cut in loose and dense sands, deep open cut in normally loaded and stiff clays. Heaving of vertical cuts in clay

Earth Dams: Introduction: Historical Development, selection of dam site, types of embankment dams, choice of type of dam, components of a dam, free board, slope protection, cause of failure, criteria for safe design. Foundation Exploration and Materials for Embankments: Methods of investigations, properties of ground, field and laboratory tests, suitability criteria for materials, critical conditions in earth dam; end of construction, steady seepage, rapid draw down. Drainage of Embankment: Horizontal drain, chimney drain, design of filter, use of impervious core in seepage control.

Control of Seepage through foundation: General consideration, treatment of foundation; trench cut off partial cut off, grout cutoff, upstream impervious blanket, design of relief well.

Instrumentation in Earth Dam: Measurement of pore pressure, movement of dam and seepage, Instruments for measuring horizontal and vertical movement. Peizometers; types, choice for location, Instruments for measuring seepage.

Stability Analysis of Slope: Effective and total stress approach, shape of slip surface, methods of slices, graphic methods, location of critical slip circle, wedge analysis method, stability during critical conditions, stability during earth quake, Indian standard Code s of practice.

Quality Control in Construction: Method of compactions, quality control of compaction in the field, borrow area control.

Arching Action in Soils: Arching in soil, theory of arching in soils, practical utility of arching in various field problems.

Dewatering: Approximate computation for flow quantity to dewater an excavation, slurry wall and safety factor. Simple sketches to illustrate the principles of dewatering by different methods and their relative suitability. Ditches and sumps, well point system, deep well drainage installation, vacuum method Bleeder wells, sand drain installation, electro-osmosis.

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Assignment / Project: Design of sheet piles and coffer dams for a real project using site specific data.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Carry out the stability analysis of the slopes by different methods.
2. Understand the different technical aspects in cofferdams and Sheetpiles.
3. Understand the instrumentation in Earth Dams.

Recommended Books:

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PIN 113: DESIGN OF WATER SUPPLY AND SWERAGE SYSTEMS

Course Objectives: To understand various processes and design criteria involved in the treatment of water or waste water.

Introduction: Review of Unit processes and operations, characteristics of water and wastewater and gaseous effluents.

Treatment Systems: Preliminary Treatment Systems and their Design; Design of Secondary treatment units, Advanced Treatment Systems and Miscellaneous Methods

Review of Sewage and its characteristics: Biological Treatment, Aerobic and anaerobic processes and their applications in the waste waters treatment.

Aerobic Treatment units: Principles, design and operation of different systems.

Anaerobic Treatment Units: Principles, design and operation of different units

Other Treatment methods: Tertiary and other advanced treatment methods

Assignment/Project:
1. Design of water supply system for the urban city.
2. Design of sewerage system for the city.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Design the various units of water supply system
2. Design the various units of waste water treatment
3. To analyse the existing water supply system to meet the demand
4. To analyse the existing sewerage system and its effective operation

Recommended Books:
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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PIN114: SMART MATERIALS AND STRUCTURES

Course Objectives: To understand the mechanism of working of supplementary cementing materials in concrete for production of high performance concrete

Supplementary Cementing Materials: Types of supplementary cementing materials such as fly ash, silica fume, rice husk ash, and metakaolin; their physical, chemical, mineralogical properties; Effects of these materials on the fresh properties; Strength properties; Durability properties.

Fibre Reinforced Concrete: Definition; types of fibres; Properties of fibres; Factors affecting FRC. Mixing and casting procedure; Composite materials approach; Effect of fibres on the workability, strength and durability of concretes; Applications of different types of fibres.

High Volume Fly Ash Concrete: Definition, Effect of types of fly ash in large quantities on the strength properties of concrete; Durability and abrasion resistance of HVFA; Applications of HVFA.

Self-Compacting Concrete (SCC): Definition, Advantages and disadvantages of SCC; Various mix design procedures; Tests for SCC; Applications for SCC.

High Performance Concrete: Definition of HPC; Material selection and its properties; Parameters for concrete being considered as HPC; Applications of HPC.

Polymer Concrete Composites: Definition; Types of monomers and polymers; Types of polymer concretes and their applications.

Fibre Reinforced Plastics (FRP): Types of FRP, their properties and effects on concrete elements under various loading conditions.

Use of Waste Materials and By-products: Types of waste materials and by-products such as waste glass, scrap tires, waste foundry sand, clean coal ash, etc. Effect of these materials on the various properties of mortar and concrete; Introduction of leachates from waste materials and their analysis.

Behaviour of Concrete at High Temperature: Definition of high temperature; Mechanism of concrete failure at high temperature; Spalling characteristics; Difference in the behaviour of normal concrete, High strength concrete and self-compacting concrete at high temperature.

High Strength steel

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Assignment/Project: To study different types of structural concrete and experimentally evaluate their properties.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Conceptualize the use of supplementary cementing materials in concrete
2. Understand the behaviour of properties of fly ash concrete, fibre reinforced concrete and high performance concrete
3. Understand the properties of concrete made with waste materials and industrial by-products
4. Conceptualize new developments in concrete technology in terms of Self compacting concrete, polymer concrete, FRP and concrete at high temperature

Text Books:

Reference Books:

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PIN211: HYDROPOWER ENGINEERING

Course Objectives: To understand different components of hydro-power plant and use of hydropower plant.

Introduction: Role of Hydropower, Types of hydropower plant

Water conveyance: Classification and design criteria of Penstock, Anchor blocks, conduit valves, bends and manifolds, Water hammer, Surge tanks

Turbines: different models – classification - suitability of different types, Velocity triangles, Draft tubes, Cavitation in turbines, Performance characteristics

Components of hydropower plants: power system terms and definitions, water power equations, hydraulic transients, demand curve, power economics, small hydropower development.

Assignment/Project: Design of the hydropower unit based on the power demand for a site specific data.

Course Learning Outcomes (CLO):

After the completion of this course the student would be able to:
1. Design the various components on a hydro power project
2. Analysis for the performance of turbines
3. Design of the hydropower unit based on the power demand

Recommended Books:

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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PCE212: TALL STRUCTURES

Course Objectives: To be able to analyze and design of tall structural systems

Principles of Planning of Tall Buildings: Technological Planning, Mechanical systems, Fire rating, Local considerations, Structures elements, Types of structural systems for tall buildings, Shear Walls and their arrangement

Loads on Tall Buildings: Gravity loads, Live loads, Wind loads and seismic loading, Code Provisions, Discussion of relevant codes of practices and loading standards, Fire Tender Loading

Analysis of Tall Buildings (With and Without Shear Walls): Approximate analysis for gravity loads, Lateral loads, Analysis of tube-in-tube constructional and 3-Dimensional analysis of shear core buildings, Stability, Stiffness and fatigue, Factor of safety and load factor

Design of Tall Buildings: Procedures of elastic design, Ultimate strength design and Limit state design of super structures including structural connections, soil structure interaction

Introduction to dampers

Assignment/Project: Plan a tall building and perform design of shear wall for it

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Plan tall buildings considering structural systems, fire rating, local considerations etc.
2. Evaluate loading for tall structures
3. Analyze and design of tall structural systems including structural connections
4. Analyse tube-in-tube construction and 3-dimensional analysis of shear core building

Text Books:

Reference Books:
1. Symposium on Tall Buildings with particular reference to Shear Wall Structures, held at University of Southampton (1996).

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
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PIN301: MASS TRANSPORTATION SYSTEMS

Course Objectives: To enable the students to develop the mass transportation systems

History and role of Transit: Recent Trends Mass Transportation Characteristics. Demand characteristics, Spatial, Temporal and Behavioural Characteristics of Transportation Demand


Terminals and their Functions: Design, Typical Characteristics. Scheduling, Service Analysis, Vehicle Dispatch Policy, Vehicle Requirements, Spacing of Bus Troops, Route Spacing and Performance


Introduction to Integrated Transportation Systems

Assignment/ Project: Design & Planning of Urban Mass Transportation System.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Design the planning for the Urban Mass Transportation Systems.
2. Design the terminals for the transportation systems.
3. Analyse the operational and management issues in mass transportation systems.

Recommended Books:

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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PIN213: TRAFFIC ENGINEERING

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Course Objectives: To understand the different concepts & characteristics of the traffic.

**Traffic characteristics:** Basic characteristics of Traffic- Volume, Speed and Density- Relationship among Traffic parameters

**Traffic Measurement:** Traffic Volume Studies-Objectives- Types of Volume Studies – Concept of PCU- Data Collection and Presentation – Speed Studies – Types of Speeds - Objectives of Speed Studies- Methods of Conducting speed studies- Data collection and Presentation- Statistical Methods for Analysis of Speed Data

**Highway Capacity:** Definition of Capacity – Importance of capacity – Factors affecting Capacity- Concept of Level of Service- Different Levels of Service- Concept of Service Volume- Peak Hour Factor

**Parking Studies:** Types of parking facilities – On street and Off Street Parking Facilities- Parking Studies- Parking Inventory Study – Parking Survey by Patrolling Method- Analysis of Parking Data and parking characteristics-Multi Story Car Parking Facility- Design standards


**Traffic and Environment:** Detrimental effect of traffic on environment – Air Pollution – Pollutants due to Traffic – Measures to reduce Air Pollution due to Traffic- Noise Pollution – Measures to reduce Noise Pollution

**Traffic Signs and Road markings:** Types of Traffic Signs- cautionary, Regulatory and Informative Signs- Specifications- Pavement markings- Types of Markings – Lane markings and Object markings- Standards and Specifications for Road Markings

**Highway Safety:** Problem of Highway Safety – Types of Road accidents- Causes – Engineering Measures to reduce Accidents- Enforcement Measures – Educational Measures- Road Safety Audit- Principles of Road Safety Audit

**Assignment / Project:** - To perform various traffic studies for the Urban City.

**Course Learning Outcomes (CLO):**
After the completion of this course the student would be able to:
1. Perform the traffic volume studies.
2. Perform the parking studies.
3. Perform the Road Safety Audits.

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Recommended Books:

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PIN221: ADVANCED HYDROLOGY

Course Objectives: To understand different various processes involved in the hydrology and analysis of hydrologic systems

Review of basic concepts in hydrology: Hydrologic cycle, systems concept - hydrologic processes, precipitation, evaporation, surface flow, sub-surface flow, and groundwater flow - hill slope processes and runoff generation, Stream flow measurements

Hydrologic Analysis: watershed concepts, rainfall-runoff Modeling,, hydrograph analysis, unit hydrograph theory, linear and kinematic wave model, and overland flow models

Flood routing: Introduction to hydraulic and hydrologic routing - The Saint-Venant Equations for open channel flow, flood wave propagation, kinematic diffusion wave approximations.

Hydrologic Statistics: Statistical parameter estimation, probability distribution, goodness of fit, Time Series Analysis - Hydrologic real time forecasting: Probability, risks and uncertainty analysis for hydraulic and hydrologic design; Regional Flood Frequency analysis.

Hydrologic Simulation Models: Hydrologic model classification, philosophy of mathematical models of watershed hydrology, steps in watershed modeling, major hydrologic models.

Urban watershed Hydrology

Ground Water Hydrology: Well hydraulics, Analysis of pumping test data, Groundwater recharge;

Water logging and salinity

Assignment/ Project: Hydrological analysis of a catchment.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. To design the various hydrologic processes and their governing equations
2. To analyse the flood routing through an open channel
3. To analyse the hydrologic system statistically to predict the probable occurrences of an hydrologic event
4. To learn the efficient use of ground water and its management

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PIN222: GROUND IMPROVEMENT

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Course Objectives: To understand the different ground improvement techniques for different types of soil.

General Principal of Compaction: Mechanics, field procedure, quality control in field

Ground Improvement in Granular Soil: In place densification by Vibrofloatation, Compaction pile, Vibro Compaction Piles, Dynamic Compaction, and Blasting


Ground Improvement by Grouting: Grouting in soil, types of grout, desirable characteristics, grouting pressure, grouting methods

Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Stability and Design of Reinforced earth retaining wall Types of geosynthetics, Physical and Engineering properties of geosynthetics. Functions of geosynthetics, applications and designing with geosynthetics in pavement, foundations, embankments, retaining walls and filtration


Assignment / Project: Design and analysis for the RE walls for the highway projects

Course Learning Outcomes (CLO): After the completion of this course the student would be able to:
1. Use the techniques of ground improvement in cohesive and granular soils.
3. Perform the various soil stabilization techniques.

Recommended Books:

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)

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PIN223: DESIGN OF PAVEMENTS

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**Course Objectives:** To understand the various design & maintenance aspects of the pavements.

**Importance and functions of various component of pavement structures:** Stresses in flexible pavements, Analytical techniques, Multilayered solutions, Design concepts, Sub grade stresses and deflection, Shear failures, equivalent single wheel and axle loads, vehicle Damage factor, Loading characteristics, Static, Impact and repeated loads, Effects of dual and tandem axles. Tyre pressure and total load, Equivalent stress and equivalent deflection criterion, wheel load, climatic and environmental factors, structural and functional distress in pavements

**Design of flexible & rigid pavements:** CBR method, Triaxial method, Mcleod method, Analytical methods, Multilayer elastic theory and design, Design for low cost pavements, Rigid pavements, Equivalent wheel load, Stresses, Sub grade theories, Westergaard’s analysis, Methods of design for dense liquid, Elastic solid sub grades, Temperature stresses and their evaluation, CRC Pavements Prestressed concrete slabs, Tie bars, Dowel bars, SFRC pavements, Pavement flexible and rigid overlay, IRC method of design.

**Pavement Management Process:** Pavement Evaluation and Performance. Design Alternatives; Analysis Evaluation and Selection, implementation of PMS. Case Studies related to PMS.

**Assignments / Projects:-**
1. Design the flexible pavement as per IRC 37:2012 for the given traffic data.
2. Design the rigid pavements as per the IRC guidelines.

**Course Learning Outcomes (CLO):**
After the completion of this course the student will be able to:
1. Perform the design of the flexible pavements using different IRC design methods.
2. Perform the design of the rigid pavements using different IRC design methods.
3. Develop the Pavement Maintenance Management systems for the flexible & rigid pavements.

**Recommended Books:**

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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PIN224: INTELLIGENT TRANSPORTATION SYSTEMS

Course Objectives: To understand the implementation of intelligent transportation systems.

Advanced traveller information systems: transportation network operations; commercial vehicle operations and intermodal freight

Public transportation applications: ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions, ITS and safety

ITS as a technology: deployment program, research, development and business models, ITS and sustainable mobility, travel demand management, electronic toll collection, and ITS and road-pricing

Use of ITS for remote monitoring of bridge performance

Assignment / Project: Case study of ITS in public transportation system.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Implement the ITS in public transportation systems.
2. Use ITS for the travel demand management.
3. Use ITS for evaluation of bridge performance.

Recommended Books:

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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
PCE211: ADVANCED BRIDGE DESIGN

Course Objectives: To analyze and design various types of bridges

General: Bridge System, Considerations in alignment, Planning, Economic consideration, Aesthetics and selection of type of bridge (Review)

Loading Standards: Standards followed in U.K., U.S.A. and Europe

Super Structure Analysis: Bridge deck analysis using different methods, Load distribution theories – Courbon specifications for loading, Geometrical proportioning etc. of road, rail-cum-road bridges, Indian Road Congress (IRC) and Indian Railway Loading standards and their comparison with loading, Hendry-Jaeger, Morris-Little (Orthotropic plate theories) methods, Stiffness method, Finite difference method, Folded Plate method, Finite strip method and Finite Element method (General treatment), Limit analysis, Design of bridge decks.

Continuous Bridges: Introduction to IRC 112: Provisions of Earthquake Resistant Design of Bridges

Connections: Design of different connections, Bearings and joints

Substructure Analysis and Design: Piers, Abutments, Wing walls and other appurtenant structures

Foundations: Well foundations and pile foundation, Design and construction and field problems

Construction & Maintenance: Erection of bridge super structure, Maintenance, Rating and Strengthening of existing bridges

Dynamics Behaviour: Behaviour of bridges under dynamic loads, Discussion of code provisions for design of bridges for wind and earthquake forces

Long Span Bridges: General discussion of suspension and cable stayed bridges

Assignment/Project: To design sub and super structure of RCC bridge

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Understand the concept of planning and investigation for bridges
2. Analyze and design superstructures for various types of RCC bridges
3. Analyze and design various types of substructures and foundations
4. Perform dynamic analysis of bridges

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
**Text Books:**

**Reference Books:**
3. Relevant Road & Railway Codes for Bridges.

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PIN311: MECHANICS OF SEDIMENT TRANSPORT

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Course Objectives: To understand various processes involved in the transportation of sediment in an open channel

Importance of sediment transport: Properties of sediment, Laminar and turbulent boundary flows, rough and smooth bed

Particle properties and mechanics: Particle settling, Forces on particles in fluid, initiation of motion and transport processes

Modes of sediment transport: Bed load, suspended load, Mechanics of sediment transport, Shield’s Entrainment method, Flow regimes and resistance, Bed formations, Form drag and grain roughness Computation of suspended load: Rouse equation, sediment concentration curve

Computation of bed load: Mathematical equations for bed load, Empirical formulas, Einstein’s bed load equation, Regime concept, Design of stable channels, Kennedy’s and Lacey’s theory, seepage effects

Riverine morphology and sediment transport phenomena: Channel classification and transport regimes, River meandering and braiding, aggradation and degradation, scour around bridge piers River training works

Assignment/ Projects: Experimental analysis of sediment transport in an open channel flow.

Course Learning Outcomes (CLO):

After the completion of this course the student would be able to:
1. Understand the sources of the sediment in an open channel
2. Understand the problems associated with the excess sediments and its controlling variables
3. Predict the scour phenomenon in an alluvial channel
4. Predict the bedforms and sediment loads in an alluvial channel

Recommended Books:

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PIN312: RETAINING STRUCTURES

Course Objectives: To understand the design concepts of various retaining structures

Design of tanks: Types and Design joints, cylindrical tanks and towers, Rectangular tanks on ground, underground and O.H.S.R.S., Hydrodynamic pressures under earthquakes

Design of Intze tank: Design of cylindrical and Intze tanks as shells of revolution taking into account the effects of continuity

Design of water towers: With parallel and splayed legs for wind and earthquake forces

Silos and Bunkers: General, Johnson’s theory, Airy’s Theory, Design of silos and bunkers by limit state theory

R.C.C. Pipes: Introduction. Stresses due to hydrostatic pressure, self weight and weight of water, earth fill over haunches, uniformly distributed load on top, design of pipes

Soil Retention Systems

Assignment /Project: Structural design of retaining structures for the infrastructure projects.

Course Learning Outcomes (CLO):
After the completion of this course the student would be able to:
1. Design the ground, underground and overhead reservoirs
2. Design the Intze tank and water towers.
3. Design the silos and bunkers.

Recommended Books:
2. IS 3370 codes on liquid retaining structures

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91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Course Objectives: To understand the various concepts of repairs, rehabilitation and retrofitting of structures

Maintenance and repair strategies: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of distress and deterioration of concrete- Evaluation of existing buildings through field investigations, Seismic evaluation of existing buildings


Repairs, Rehabilitation and Retrofitting of structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure - Special techniques for structural Retrofitting (Bracing, Shear walls, Base isolation etc).

Demolition techniques: Engineered demolition techniques for Dilapidated structures – case studies - Case Studies on Restoration of fire damaged buildings, Case study on repairs and strengthening corrosion damaged buildings; Case study on use of composite fibre wraps for strengthening of building components.

Assignment / Project:-Case studies of retrofitted structures.

Course Learning Outcomes (CLO):
After the completion of this course the student will be able to:
1. Develop various maintenance and repair strategies.
2. Evaluate the existing buildings through field investigations.
3. Understand and use the different techniques for structural retrofitting.


**Recommended Books:**


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PIN314: ADVANCED RAILWAY AND AIRPORT ENGINEERING

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**Course Objectives:** To understand the various advanced aspects of railway and airport engineering.

**Railway:** Importance of transportation systems. History of railways and its development, development of Indian Railways - Surveys for Route location - Permanent way and its component parts Formation, Ballast, Sleepers, Rails. Creep and Tilt in Rails. Track fittings and fastenings - Points and crossings - Track resistance and tractive effort. Gauge problem, super-elevation near branching of curves; gradients - Station Platforms - Various types of yards and sidings - Signals.

**Airport Engineering:** Introduction, classification of airports; planning, Surveys and site selection of airports.

**Airport Geometrics:** Runway Length, Patterns and orientation- wind rose diagram - Width and grades of runway; Taxiways and aprons.

**Airport Pavement Design:** Difference between Highway and airport pavements; Introduction to various design methods. LCN-ACN methods of the Pavement Evaluation. Pavement Management Systems for the airport pavements. Airport drainage.

**Assignment / Project:**
1. To design the flexible & rigid runway & apron pavements.
2. To design the turnout as per the Indian Railway specifications.

**Course Learning Outcomes (CLO):**
After the completion of this course the student will be able to:
1. Design the permanent way sections for the railways.
2. Perform the geometric design of runways and taxiways.
3. Design & evaluate the various airport pavements.
4. Develop the Pavement Management System for airport pavements.

**Recommended Books:**

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PIN315: DISASTER MITIGATION AND MANAGEMENT

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**Course Objectives:** To understand the various aspects of disaster mitigation and management.

**Natural Disasters:** Meaning and nature of natural disasters, their types and effects - Floods, drought, cyclone, earthquakes, landslides, avalanches

**Earthquake:** Description, Causes of earthquakes, distribution of earthquakes, Mitigation and management

**Flood hazards - Control and management:** Causes of floods, Environmental risks, Methods of flood forecasting, Mitigation planning in a flood prone area, flood plain management, Measures to mitigate flood damage, Flood control economics

**Volcanic eruptions, Heat and cold waves, ozone depletion**

**Climatic change:** global warming, Sea level rise

**Man Made Disasters:** Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents

**Disaster Management:** Meaning, concept, principles, scope, objectives, and approaches. Element of disaster management; International strategy for disaster reduction; Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community – based organizations and media; Central, state, district and local administration

**Disaster Mitigation:** Hazard assessment, Vulnerability assessment, Risk assessment

**Remote-sensing and GIS applications:** Applications real time disaster monitoring, prevention and rehabilitation, Case Studies

**Assignment / Project:** Case study of the frameworks of various disaster management systems

**Course Learning Outcomes (CLO):**
After the completion of this course the student will be able to:

1. Develop the framework for the disaster management & disaster mitigation.
2. Classify various types of the natural and manmade disasters.
3. Use the GIS and Remote sensing techniques for the real time disaster monitoring.

91st Senate approved Courses Scheme & Syllabus for ME-Infrastructure Engg. (2017)
Recommended Books:

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PIN391: SEMINAR

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Course Objectives: This course is designed to help the students to obtain skills to discuss or present something within a group. Seminar presentation of ME Seminar Course is an outcome of six months of study, exploration, survey and analysis of a particular topic.

Course Learning Outcomes (CLO):
After the completion of this course the student will be able to:
1. Identification of a domain specific scholarly topic
2. Investigate and tabulate details and history about the selected topic
3. Application of the selected topic in domain or real life
4. Technical report writing
PIN392: MINOR DESIGN PROJECT

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**Course Objectives:** This course is designed to encourage design projects where students take what they’ve learned throughout the course of their ME program and apply it to examine a specific idea.

**Course Learning Outcomes (CLO):**
After the completion of this course the student will be able to:

1. Investigate and identify real world problems
2. Design, develop and implement a domain specific project
PIN491: DISSERTATION

Course Objectives: To expose students to research work in the area of their interest

Extensive research is carried out on one topic by each student by conducted experiments in the lab or by developing analytical models by using software’s. They shall be evaluated on the basis of dissertation report and viva-voce examination.

Course Learning Outcomes (CLO):
The students will be able to:
1. Design and implementation of identified research problem.
2. Develop acumen for higher education and research.
3. Technical report writing and Publication of research work in referred journals, National and International conferences of Repute
4. Ability to foresee how their current and future work will influence/impact the economy, society and the environment.

Evaluation Scheme:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Evaluation Elements</th>
<th>Weightage (%)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Research paper</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Report</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>External Evaluation</td>
<td>40</td>
</tr>
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