PREFACE

CIVIL: Engineering Department of Zakir Husain College of Engineering & Technology started in 1942, trains the students for the cause of technical education. The department pursues education through enrichment of engineering principles, analytical and application skills along with overall personality development. This has resulted in preparing our students to be ready for new economic order and challenges, at par with the best of institutes of the country and abroad.

Engineering education has become an international enterprise, following major internationalization trends in engineering practice itself over recent decades. India has been admitted on 13th June, 2014 as a signatory of Washington Accord through National Board of Accreditation (NBA) agency, which is a step ahead towards outcome based education approach. After successful completion of accreditation by NBA from 2009 - 2014 for five years, the department is moving towards outcome based education approach by renewing its accreditation status through NBA in line with the Washington Accord.

The curriculum for undergraduate engineering course has become more structured by the introduction of courses which demonstrate a range of skills, from technical problem solving to soft skills and an aptitude for lifelong learning apart from courses which equip engineering students with a wider horizon of concepts in terms of environmental, economic, and social attributes, for decision making of sensitive to sustainability issues.

This booklet contains the vision and mission of the department, programme educational objectives, program outcomes, ordinances & regulations, revised course structure and syllabi with course objectives and outcomes recommended by the board of studies of the Civil Engineering Department, endorsed by faculty of Engineering and Technology and approved by Academic Council of AMU, Aligarh.

I sincerely thank and express my gratefulness to all the colleagues of the department for their useful comments and suggestions.

Special thanks are due to Dr. M. Masroor Alam and Mr. Sabahat Ali Khan for their efforts in the preparation of this document.

Dr. Mohammed Arif
Professor and Chairman
Department of Civil Engineering
Zakir Husain College of Engineering and Technology
Aligarh Muslim University
Aligarh-202 002, India.

July 16th, 2014
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information about the Department</td>
<td>iii</td>
</tr>
<tr>
<td>Vision and Mission of the Department</td>
<td>xx</td>
</tr>
<tr>
<td>Programme Educational Objectives</td>
<td>xxi</td>
</tr>
<tr>
<td>Programme Outcomes</td>
<td>xxii</td>
</tr>
<tr>
<td>B. Tech. Ordinances</td>
<td>xxiii</td>
</tr>
<tr>
<td>B. Tech. Regulations</td>
<td>xxx</td>
</tr>
<tr>
<td>Course Structure B. Tech. Civil Engineering</td>
<td>1</td>
</tr>
<tr>
<td>Course Syllabi</td>
<td>11</td>
</tr>
</tbody>
</table>
GENERAL INFORMATION ABOUT THE DEPARTMENT
DEPARTMENT OF CIVIL ENGINEERING

HISTORICAL PERSPECTIVE

1936  Zakir Husain College of Engineering and Technology was established
1942  U. G. Course in Civil Engineering was started
1965  P. G. Courses in Civil Engineering was introduced
1969  Doctoral Program in Civil Engineering was started
2009  Five year accreditation awarded by NBA
INTRODUCTION

The Department of Civil Engineering in the Faculty of Engineering and Technology has been constantly contributing to the cause of engineering education and training right since its inception in the year 1942. Over the last five decades the department has grown manifold and shared immensely in technology transfer and the propagation of technological advancements to industry in particular and to the masses in general. With the changing technological order across the country and globe, the Department too has maintained pace in becoming at par with the latest and most sophisticated R&D, design, testing, instrumentation and computational facilities etc. The training and education of the personnel in a wide range of fields has been a constant endeavor of the Department over these years.

The Department has highly qualified faculty supported by excellent laboratories and state of the art computing facilities. The Department owns a rich library having over 12000 text and reference books. Many research projects sponsored by A.I.C.T.E, U.G.C., D.S.T., C.S.I.R., D.R.D.O., C.S.T.(UP), Ministry of Environment and Forest (M.O.E.F), and Indian Oil Corporation, Govt. of India have been successfully completed and many under progress. The faculty members have published a good number of Research papers in International and National Journals as well as in the Proceedings of various International and National Seminars, Conferences, Symposia and Workshops. The faculty members have also published several textbooks and prepared appreciable number of Technical Reports, Laboratory Manuals and other Teaching Aids.

The faculty members have also to their credit many awards such as Khosala Award, Suchit Kumar memorial Award, Institution of Engineers(I), Khosala Research Prize, ISET Best Prize award, Deshpande Award (FM &FP, India), Jai Krishna Award, Sir Arthur Cotton Memorial Gold Medal, Career Award for Young teachers etc. Many faculty members have chaired technical session of different National and International meets and have also been the members of various technical committees within the country and abroad as well. The Department organized two international conferences one in 2009 and other in 2011 in the area of environmental engineering in collaboration with foreign university. In addition a number of seminars and workshops including training programs have also been successfully organized in last five years. The department has carried out consultancy work for different state and national government and private organizations. The revenue generated from externally funded R&D projects and consultancies has been over 950 Lac rupees. The Department has entered into collaborative programmes with industry and foreign universities. Collaborative work is in progress with Toledo University, USA; Youngstown State University, USA; Michigan University, USA; Asia Pacific University, Thailand and La Sierra University, USA. The National Board of Accreditation (NBA), New Delhi accredited the department of civil engineering for full five years from 2009-14 and is presently under renewal stage.

At the under graduate level, the Civil Engineering Department offers B. Tech. (Civil) course and at the post graduate level M. Tech. course is offered in three major fields of specialization viz. Structural Engineering, Hydraulic Structures, and Environmental Engineering. At the Doctoral level, the Department offers Ph.D. in Structural Engineering, Hydraulic Structures, Environmental Engineering and Geo technical Engineering. Zakir Husain college of Engineering and Technology is one amongst the 150 institutes identified by M.H.R.D., Government of India, for funding under TEQIP-II.
<table>
<thead>
<tr>
<th>Name of the Programme</th>
<th>Duration (years)</th>
<th>Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Tech. (Civil Engineering)</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>B. E. (Civil Engineering), Evening Course</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>M. Tech.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Engineering</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Hydraulic Structures</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Ph. D. (Civil Engineering)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MAJOR THRUST AREAS OF THE DEPARTMENT

STRUCTURAL ENGINEERING
Earthquake Resistant Construction
Experimental Stress Techniques and Non-Destructive Testing
Fibre Composites and New Construction Materials
Numerical Modelling and Optimization Techniques
Offshore Structures
Reliability Analysis and Risk Assessment of Structures
Structural Masonry
Transient Dynamic Analysis of Structures
Wind Engineering

HYDRAULIC STRUCTURES
Computational Hydraulics
Flow through porous media
Hydrology
Sediment Transport

ENVIRONMENTAL ENGINEERING
Air Pollution
Biological Processes for Wastewater Treatment
Corrosion Control
Hazardous and Solid Waste Management
Modeling and Simulation of Treatment Processes
Physio-Chemical Treatment Processes

GEOTECHNICAL ENGINEERING
Flyash Utilization and Disposal
Ring/Annular/Shell and Pile Foundations
Soil Structure Interaction
Environmental Geotechnology
Application of Geo-synthetics in Ground Improvement Techniques
Geo-Engineering
Rock Mechanics
LABORATORIES

Structural Engineering
- Structural Mechanics Laboratory
- Concrete Laboratory
- Structural Dynamics Laboratory
- Heavy Structures Laboratory
- Polymer Concrete Laboratory
- Composite Materials Laboratory
- Corrosion and Non Destructive Testing Lab (NDT)
- Drawing Hall

Hydraulic Structures
- Hydraulics U.G/P.G Laboratory
- Advanced Hydraulics Laboratory

Environmental Engineering
- Environmental Engineering U.G. Laboratory
- Environmental Engineering P.G. Laboratory
- Advanced Environmental Engineering Laboratory

Geotechnical Engineering
- Soil Mechanics Laboratory
- Transportation Engineering Laboratory
- Engineering Geology Laboratory

Surveying
- Surveying Laboratory

CAD Laboratory
<table>
<thead>
<tr>
<th>Name of Faculty Members</th>
<th>Highest Qualification</th>
<th>University</th>
<th>Designation</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR. MOHAMMED ARIF</td>
<td>Ph. D.</td>
<td>Univ. of Roorkee, Roorkee</td>
<td>Professor and Chairman</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. SARFARAZ ALI ANSARI</td>
<td>Ph. D.</td>
<td>Univ. of Roorkee, Roorkee</td>
<td>Professor</td>
<td>Hydraulic Structures</td>
</tr>
<tr>
<td>DR. MOHD. MUZZAMMIL</td>
<td>Ph. D.</td>
<td>IIT, Kanpur</td>
<td>Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. ABDUL BAQI</td>
<td>Ph. D.</td>
<td>Univ. of Roorkee, Roorkee</td>
<td>Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. SHAKEEL AHMAD</td>
<td>Ph. D.</td>
<td>Univ. of Roorkee, Roorkee</td>
<td>Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. AMJAD MASOOD</td>
<td>Ph. D.</td>
<td>IIT, Roorkee, Roorkee</td>
<td>Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. MOHD ATHAR</td>
<td>Ph. D.</td>
<td>Univ. of Roorkee, Roorkee</td>
<td>Professor</td>
<td>Hydraulic Structures</td>
</tr>
<tr>
<td>DR. TABASSUM NAQVI</td>
<td>Ph. D.</td>
<td>IIT, Delhi</td>
<td>Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>MR. FARRUKH GHANI</td>
<td>M. Tech.</td>
<td>AMU, Aligarh</td>
<td>Associate Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>MR. SAJID ALI KHAN</td>
<td>M. Tech.</td>
<td>AMU, Aligarh</td>
<td>Associate Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>MR. SYED ASHRAF ALI</td>
<td>M. Tech.</td>
<td>AMU, Aligarh</td>
<td>Associate Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. TAZYEEN AHMAD</td>
<td>Ph. D.</td>
<td>AMU, Aligarh</td>
<td>Associate Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. TALIB MANSOOR</td>
<td>Ph. D.</td>
<td>Univ. of Roorkee</td>
<td>Associate Professor</td>
<td>Hydraulic Structures</td>
</tr>
<tr>
<td>Dr. ARSHAD UMAR</td>
<td>Ph. D.</td>
<td>IIT, Delhi</td>
<td>Associate Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. IZHARUL HAQ FAROOQI</td>
<td>Ph. D.</td>
<td>AMU, Aligarh</td>
<td>Associate Professor</td>
<td>Environmental Science &amp; Engg.</td>
</tr>
<tr>
<td>DR. SHAMSUDDIN JAFRI</td>
<td>Ph. D.</td>
<td>IIT, Delhi</td>
<td>Associate Professor</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. MUBEEN BEG</td>
<td>Ph. D.</td>
<td>AMU, Aligarh</td>
<td>Associate Professor</td>
<td>Hydraulic Structures</td>
</tr>
<tr>
<td>DR. JAVED ALAM</td>
<td>Ph. D.</td>
<td>AMU,</td>
<td>Associate</td>
<td>Hydraulic</td>
</tr>
</tbody>
</table>
| Name                        | Designation          | Ph. D. Location | Degree
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DR. (MAJOR) FAREED MAHDI</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. HASSAN IRTAZA</td>
<td>Professor</td>
<td>Oxford Brookes University, UK</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. SABIH AKHTAR</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. SOHAIL AYUB</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Environmental Science &amp; Engg.</td>
</tr>
<tr>
<td>DR. ASIF ALI SIDDIQUI</td>
<td>Professor</td>
<td>University of Southampton, UK</td>
<td>Environmental Science &amp; Engg.</td>
</tr>
<tr>
<td>DR. IQBAL KHALIL KHAN</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. MEHBOOB ANWER KHAN</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Geotechnical Engg.</td>
</tr>
<tr>
<td>DR. MUJIB AHMAD ANSARI</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Hydraulic Structures</td>
</tr>
<tr>
<td>DR. MALIK SHOEB AHMAD</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Geotechnical Engg.</td>
</tr>
<tr>
<td>DR. REHAN A KHAN</td>
<td>Professor</td>
<td>IIT, Delhi</td>
<td>Structural Engg.</td>
</tr>
<tr>
<td>DR. NADEEM KHALIL</td>
<td>Professor</td>
<td>IIT, Delhi</td>
<td>Environmental Science &amp; Engg.</td>
</tr>
<tr>
<td>DR. MOHD. MASROOR ALAM</td>
<td>Professor</td>
<td>AMU, Aligarh</td>
<td>Engg. Geology</td>
</tr>
</tbody>
</table>
ACHIEVEMENTS

Enhance Research and Development Activity

- The impetus on research and development facility and consultancy work was the focus in last 4-5 years which has resulted into funding to the tune of more than Rs. 950 Lacs from various International and National agencies to the department and individual faculty members.

- The notable agencies are European Union (AMU Share), UNICEF, DST (PURSE), UGC, MHRD (TEQIP-II), MOEF, AICTE, UPCST etc.

- Number of Ph.D. Awarded: 12
- Number of Ph.D. Enrolled: 10
- No. of publications by the faculty members: Total publication = 210 (Journal = 121, Conferences = 89)
- Books published = 05
- Chapter in edited Books published = 04 + 01 (Accepted)
- Number of patents: The faculty members have filed 02 patents
- The department has organized two international conferences:

- The department has conducted 10 Workshops, 04 Short-term Training Programs, 05 Extension Lectures and 01 Summer University in last three years.

Closer Institute-Industry Interaction

- Institute-Industry interaction cell in the college has been created which is represented by faculty member of the department.

- The department is in continuous interaction with industry and government organizations through consultancy.

- The department is part of MOU signed with Youngstown State University, Ohio, USA through AMU, Aligarh.
Department has worked with district administration and NGOs for creating awareness in the field of disaster management.

The department has organized a large number of invited talks and training program with expert from industry.

Student’s Achievement

Following are some of the students who have brought laurels by qualifying national level administrative exams in last three years:

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Raja Yaqoob Farooq</td>
<td>Indian Administrative Services (IAS)</td>
</tr>
<tr>
<td>Mr. Syed Anwer Ali</td>
<td>Indian Engineering Services (Railways)</td>
</tr>
<tr>
<td>Mr. Zeeshan Haider</td>
<td>Indian Engineering Services (Railways)</td>
</tr>
<tr>
<td>Mr. Md Nazibullah</td>
<td>Indian Engineering Services (Railways)</td>
</tr>
<tr>
<td>Mr. Prateek Rastogi</td>
<td>Indian Engineering Services (Railways)</td>
</tr>
<tr>
<td>Mr. Rishabh Garg</td>
<td>Indian Engineering Services (Railways)</td>
</tr>
<tr>
<td>S. No.</td>
<td>Name</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>1.</td>
<td>Khan Bahadur Abdur Rahman Khan</td>
</tr>
<tr>
<td>2.</td>
<td>Dr. M. S. Qureshi</td>
</tr>
<tr>
<td>3.</td>
<td>Mr. Sher Ali Ismaili</td>
</tr>
<tr>
<td>4.</td>
<td>Prof. F. M. P. Arbuthonot</td>
</tr>
<tr>
<td>5.</td>
<td>Dr. K. C. Chakko</td>
</tr>
<tr>
<td>6.</td>
<td>Khan Bahadur Hamidullah Khan</td>
</tr>
<tr>
<td>7.</td>
<td>Prof. M. Ather</td>
</tr>
<tr>
<td>8.</td>
<td>Dr. K. C. Chakko</td>
</tr>
<tr>
<td>9.</td>
<td>Prof. M.Y. Ansari</td>
</tr>
<tr>
<td>10.</td>
<td>Prof. Rasheeduzzafar</td>
</tr>
<tr>
<td>11.</td>
<td>Prof. S. Masjood Hasan</td>
</tr>
<tr>
<td>12.</td>
<td>Prof. M.Y. Ansari</td>
</tr>
<tr>
<td>13.</td>
<td>Prof. Rasheeduzzafar</td>
</tr>
<tr>
<td>14.</td>
<td>Prof. Shamim Ahmad</td>
</tr>
<tr>
<td>15.</td>
<td>Prof. M.Y. Ansari</td>
</tr>
<tr>
<td>16.</td>
<td>Prof. S. Masjood Hasan</td>
</tr>
<tr>
<td>17.</td>
<td>Prof. Shamim Ahmad</td>
</tr>
<tr>
<td>18.</td>
<td>Prof. Aslam Qadeer</td>
</tr>
<tr>
<td>20.</td>
<td>Prof. Roshan A. Khan</td>
</tr>
<tr>
<td>21.</td>
<td>Prof. Alimul Qadar</td>
</tr>
<tr>
<td>23.</td>
<td>Prof. V. P. Mital</td>
</tr>
<tr>
<td>24.</td>
<td>Prof. S. Qaiser A. Naqvi</td>
</tr>
<tr>
<td>26.</td>
<td>Prof. Razaullah Khan</td>
</tr>
<tr>
<td>27.</td>
<td>Prof. M. M. Ashhar</td>
</tr>
<tr>
<td>28.</td>
<td>Prof. Sarfaraz Ali Ansari</td>
</tr>
<tr>
<td>29.</td>
<td>Prof. Mohammed Arif</td>
</tr>
</tbody>
</table>
ON GOING RESEARCH PROJECTS OF THE DEPARTMENT

Project Title: Seismic Assessment and Safety of Masonry Heritage
Funding Agency: UGC
Funding Amount: 72 Lacs
Principal Investigator: Prof. Shakeel Ahmad

Project Title: Seismic Reliability Analysis of Cable Supported Bridges
Funding Agency: MRP, UGC
Funding Amount: 10.65 Lacs
Principal Investigator: Dr. Rehan A. Khan

Project Title: Integrated Sustainable Power Generation from Short-Rotation Forestry (Enhanced Biomass) for Rural and Semi-Urban Areas in India
Funding Agency: Ministry of Power, Gol, under NPP scheme (CPRI, Banglore)
Funding Amount: 163.28 Lacs
Principal Investigator: Dr. Nadeem Khalil
COMPLETED RESEARCH PROJECTS OF THE DEPARTMENT

Project Title: Development of Corrosion Control Techniques for Reinforced Concrete Composites using Corrosion Inhibitors  
Funding Agency: AICTE  
Funding Amount: 10.00 Lacs  
Principal Investigator: Prof. Mohammed Arif

Project Title: Behaviour of High Strength Concrete at Elevated Temperature  
Funding Agency: AICTE  
Funding Amount: 9.00 Lacs  
Principal Investigator: Prof. Amjad Masood

Project Title: Performance Evaluation of Pilot Plant based on Sequencing Batch Reactor for the Biodegradation of Absorbable Organic Halides (AOX) from Pulp and Paper Mill Wastewater.  
Funding Agency: MOEF  
Funding Amount: 97.368 Lacs  
Principal Investigator: Dr. I. H. Farooqi

Project Title: Sediment Control in Canals- A New Approach  
Funding Agency: UP-CST  
Funding Amount: 6.45 Lacs  
Principal Investigator: Dr. Mujib Ahmad Ansari

Project Title: Seismic Vulnerability Analysis of Masonry Structures  
Funding Agency: CSIR  
Funding Amount: 6.00 Lacs  
Principal Investigator: Prof. (Mrs.) T. Naqvi and Prof. Husain Abbas

Project Title: Structural Performance of Polymer Concrete utilizing Recycled Plastic waste  
Funding Agency: AICTE  
Funding Amount: 11.85 Lacs  
Principal Investigator: Dr. Fareed. Mahdi  
Co-Principal Investigator: Prof. Husain. Abbas and Dr. Asif Ali Khan

Project Title: Petrofacies and Digenetic Evolution of Malani Volcaniclastics Barmer-Jodhpur Area  
Funding Agency: DST  
Funding Amount: 5.88 Lacs  
Principal Investigator: Dr. M. Masroor Alam

Project Title: Sediment Control in Canals- A New Approach  
Funding Agency: UP-CST  
Funding Amount: 4.65 Lacs  
Principal Investigator: Dr. Mujib Ahmad Ansari

Project Title: Development of Corrosion Arrest Technique in Ferrocement  
Funding Agency: UP-CST  
Funding Amount: 5.36 Lacs  
Principal Investigator: Dr. Sabih Akhtar
Project Title: Biological Nitrogen removal by Anammox process using Sequencing Batch Reactor  
Funding Agency: UGC  
Funding Amount: 10.568 Lacs  
Principal Investigator: Dr. I. H. Farooqi

Project Title: Performance of Sequence Reactor (SBR) for the Bio-gradation of Phenolic Compounds  
Funding Agency: UP-CST  
Funding Amount: 6.36 Lacs  
Principal Investigator: Dr. I. H. Farooqi

Project Title: Performance evaluation of pilot Plant based on sequencing Batch Reactor for the Biodegradation of Adsorbable Organic Halides AOX from Pulp and paper Mill wastewater  
Funding Agency: MOEF  
Funding Amount: 67.22 Lacs  
Principal Investigator: Dr. I. H. Farooqi
1. Project titled "Performance level benchmarking for sewage treatment plant" (in collaboration with IIT Delhi) funding agency MoEF with a grant of Rs 58.5 Lakh (2012-13) under the Co-Principal Investigator Dr. Nadeem Khalil.

2. Project titled "Integrated system for sewage treatment: A sustainable approach" (in collaboration with Tohuko University, Japan JICA-JST with a grant of US$ 2.5 Million (2011-2014) under the Co-Principal Investigator Dr. Nadeem Khalil.

3. SWINGS Project entitled "Indo-Euro Research Project on Water Challenges in India" (Consortia of 21 Partners from Europe and India, Aligarh Muslim University, Aligarh is the lead Coordinating partner) funding agency European Union Ministry of Science and Technology with a grant of Rs 2.26 Crore for AMU (total grant allocation Rs. 4.62 Crore) under the Principal Investigator Dr. Nadeem Khalil.
GRANTS AND FUNDING OF THE DEPARTMENT

2011-12
1. PURSE, DST Rs. 31.86 Lacs
2. TEQIP-II, MHRD Rs. 24.4 Lacs
3. Centre for Disaster Management (Under XIth Plan) Rs. 25.0 Lacs
4. Regular Grant Rs. 8.35 Lacs

2012-13
1. PURSE, DST Rs. 38.00 Lacs
2. TEQIP-II, MHRD Rs. 40.65 Lacs
3. XIIth Plan Rs. 102.79 Lacs
4. Regular Grant Rs. 8.35 Lacs

2013-14
1. XIIth 5 year Plan Rs. 102.79 Lacs
2. Books Rs. 1.14 Lacs
3. Regular Grants Rs. 8.35 Lacs
NOTABLE ALUMNI OF THE DEPARTMENT

1. Mr. V.K. Agrawal, Former Chairman, Railway Board.
2. Prof. Tahir Husain, Professor, University of New Foundland, Canada.
3. Prof. Shakir Husain, Youngstown State University
4. Prof. S.M.A. Kazmi, Former Professor, IIT-Delhi.
5. Mr. Zafar Iqbal, Former Indian Hockey Captain, Indian Airlines.
6. Mr. M.A.A. Fatmi, Former Minister of State, MHRD, Govt. of India.
7. Mrs. Chitra Verma Engineer in Chief U.P.PWD.
8. Mr. Shamim Khan, Chief Engineer, CPWD.
9. Mr. Shafiq Ahmad, Chief Engineer, UP Irrigation.
10. Mr. Arvind Kumar Gupta, Chief Engineer, UP Irrigation.
11. Mr. Hari Mohan Singal, SE, UP Irrigation.
12. Mr. Ajay Kumar Bansal, SE, UP Irrigation.
13. Mr. Syed Taj Mumtaz, SE, UP Irrigation.
16. Mr. Mohd. Sulaiman I.A.S.
17. Mr. Raja Yaqub Farooq I.A.S
VISION OF THE DEPARTMENT

To develop a vibrant and broad-based graduate program with emphasis on up to date curriculum, quality faculty and staff, field and industrial training to prepare engineers with state of the art knowledge for professional practice in civil engineering, guided by strong conviction towards morality and ethics.

MISSION OF THE DEPARTMENT

1. To rely on basic engineering sciences and contemporary computational tools for strengthening fundamental precepts of success for our students.
2. To create congenial environment for interaction amongst students, faculty and technical staff to facilitate open thinking and learning process.
3. Strive to maintain pace with the latest and most sophisticated innovations, research and development in the field of civil engineering within the ambit of sustainable development.
4. To be acquainted with requirements of stakeholders to incorporate changes in curriculum to facilitate acceptance of our graduates both at the national and international levels.
PROGRAMME EDUCATIONAL OBJECTIVES

PEO1 Graduates will be able to analyze, design and propose a feasible solution to civil engineering problems by applying basic principles of mathematics, science and engineering.

PEO2 Graduates will be inculcated with necessary professional skills, effective oral and written communication to be productive engineers.

PEO3 Graduates will be able to work as a team in intra and interdisciplinary endeavors for development of new ideas and products to serve in contemporary societal contexts.

PEO4 Graduates will be able to face challenges of the world economic order by incorporating expertise gained by faculty in consultancy work, for educating students, involving modern tools and techniques.

PEO5 Graduates will achieve a high level of technical and managerial expertise to achieve excellence, outstanding leadership to succeed in positions in civil engineering profession with higher threshold start in employment background.
Civil Engineering Department of Zakir Husain College of Engineering & Technology trains the students for the cause of technical education. In this department, education means enrichment of analytical and application skills of engineering principles along with overall personality development. The outcome is that our students are at par with the best of institutes of the country.

As part of the preparation process, the civil engineering department faculty, has adopted the specific program outcomes to be achieved at the civil engineering department are as follows:

a. An ability to apply knowledge of mathematics, science, and engineering.
b. An ability to design and conduct experiments, as well as to analyze and interpret data.
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
d. An ability to function on multi-disciplinary teams.
e. An ability to identify, formulate, and solve civil engineering problems.
f. An understanding of professional and ethical responsibility.
g. An ability to communicate effectively.
h. The broad education necessary to understand the impact of civil engineering solutions in a global, economic, environmental, and societal context.
i. A recognition of the need for, and an ability to engage in life-long learning.
j. A knowledge of contemporary issues.
k. An ability to use the techniques, skills, and modern engineering tools necessary for civil engineering practice.
l. An ability to explain basic concepts and problem solving processes used in management.
B. TECH ORDINANCES

CHAPTER - XXXIV (F)

Bachelor of Technology in the Faculty of Engineering & Technology
(Effective from the Session 2011 – 2012)

1. Introduction

(a) The Faculty of Engineering & Technology, Aligarh Muslim University offers full-time program leading to the Bachelor of Technology (B. Tech.) degree in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Electronics Engineering, Mechanical Engineering, and Petrochemical Engineering.

(b) The medium of instruction in B. Tech. Program is English.

2. Eligibility

A candidate will be eligible for admission to B. Tech. Program if he/she has passed the Senior Secondary School Certificate (10+2) Examination of this University or an Examination recognized by this University as its equivalent with 50% marks in aggregate of English, Physics, Chemistry, and Mathematics, or have passed the Diploma in Engineering Examination of this University with 50% marks in aggregate.

3. Admission

(a) The admissions to the B. Tech. programs will be made normally in the Autumn Semester as per the admission policy approved by the Academic Council of the University from time to time. The admission of each student will be made in a particular branch.

(b) A limited number of students may be allowed to change over from one branch of study to another, after first year of study, depending on the availability of seats and their performance in the first two semesters.

4. Academic Session

The academic session is divided into two regular semesters – Autumn and Winter, each of which shall be of approximately 20 weeks duration. The Autumn semester will normally commence in the month of July/August every year, and the Winter in the month of December/January. In the beginning of every session the Dean, in consultation with the Chairmen of the departments concerned, shall notify a detailed academic calendar indicating the schedule of teaching, examination, and other activities.

5. Duration of the Program

5.1 Minimum Duration
The minimum duration of the program shall be eight consecutive semesters after admission.

5.2 Maximum Duration
The maximum duration of the program shall be fourteen consecutive semesters after admission.

6. Curriculum and Credit System

6.1 Credit System

Each B. Tech. program will have a curriculum in which every course will be assigned certain credits reflecting its weight and contact periods per week, as given below:

\[
\begin{align*}
1 \text{ Lecture period (L) per week} &= 1 \text{ Credit} \\
1 \text{ Tutorial period (T) per week} &= 1 \text{ Credit} \\
1 \text{ Practical period (P) per week} &= 0.5 \text{ Credit}
\end{align*}
\]
In addition to theory and laboratory courses there may be other courses such as seminar, colloquium, project, etc., which will be assigned credits as per their contribution in the program without regard to contact periods.

6.2 Course Categories

The curriculum for each branch will contain courses in the following categories having credits in the ranges given below in such a way that the total of all credits will be equal to that required for the award of degree as specified elsewhere in these ordinances.

(a) Basic Sciences (BS) 20-36 credits
   (Courses such as Physics, Chemistry, Mathematics etc.)

(b) Engineering Sciences & Arts (ESA) 20-40 credits
   (Foundation and applied engineering courses that are used across many branches)

(c) Humanities and Management (HM) 10-18 credits
   (Language, Social science, & Management)

(d) Departmental Core (DC) 60-116 credits

(e) Departmental Electives (DE) 16-32 credits

(f) Open Electives (OE) 8-16 credits

6.3 Coordinators and Curriculum Development Committee

There shall be a Chief Coordinator, B.Tech. Programs, to be nominated by the Dean, and a Coordinator, B.Tech. Program for each branch in each department, to be nominated by the Chairman of the department concerned. Normally the Chief Tabulator will be the Chief Coordinator, B. Tech. Programs. There shall also be a standing Curriculum Development Committee (CDC), to be constituted by the Faculty. The Chief Coordinator, B. Tech. Programs will be the Convener of the CDC.

6.4 The Curriculum Structure

The curriculum for each branch will contain a listing of all courses, with each course having a course category, course number, course title, number of contact periods per week, number of credits assigned, and the marks assigned to various components of evaluation. It will also have a list of alternative courses in the new curriculum for the old curriculum courses and filler courses to compensate for the shortfall in credits earned by taking alternative courses in any category, if needed. It will also specify all other conditions required for the award of degree.

6.5 Approval of the Curriculum

The curriculum for each branch of B. Tech. program will be prepared by the department concerned and will be approved by the Board of Studies of the department. It will then be vetted by the CDC and will then be placed in the Faculty along with the recommendations of the CDC for approval. Once approved by the Faculty, the Curriculum will be implemented. The same procedure shall be used for any modification in the Curriculum.

7. Registration

7.1 Registration Procedure and Schedule

(a) Every student is required to register, in each semester, for the courses that he/she wants to pursue in that semester. The registration schedule will be announced by the Dean/Chairman for every semester. The registration process involves:
(i) Submitting a registration form in the office of the Chairman and obtaining a registration card signed by the Chairman;

(ii) Paying the required fees.

(b) A student will normally register for higher semester courses only if he has also registered for un-cleared courses of previous semesters, especially in the case of un-cleared courses of first two semesters.

(c) A student will have the option to add/delete/alter the courses in his/her registration within a week of the registration subject to such conditions as may be imposed by the department concerned from time to time.

(d) A student can drop a course from his/her registration by submitting a request to his/her department coordinator up to a date specified on his/her registration card. A registered course will be counted as an attempt even if the student remains absent in the Examination(s).

(e) No student will be allowed to register for more than 40 credits in a semester. A graduating course, however, will not be included in this limit.

(f) A student may be denied registration in a course due to reasons of paucity of staff or space or other facilities, especially in the case the student is registering a course for improving the grade in a passed course.

(g) If a student fails to register in two consecutive semesters without specific permission from the Dean, his/her name may be removed from the rolls of the faculty. Such a student may apply to the Dean for re-admission stating the reasons for not being able to register for two consecutive semesters and the Dean will take suitable decision on the merit of the case.

7.2 Graduating Course

A student may be allowed to register for one course of not more than 5 credits if he/she is able to graduate by passing such a course, irrespective of whether the course is being offered in the current semester to regular students or not, provided that the student has fulfilled the attendance requirement earlier and has been awarded E or I grade in that course. Such a course shall be known as a graduating course.

8. Attendance (In lieu of Chapter XVII of the Academic Ordinances)

Attendance in each course separately is compulsory at least once. Students who have put in 75% or more attendance in a course in a semester will be eligible to appear in the End-Semester Examination of that course. Students who have put in 65% or more but less than 75% attendance in a course may be considered for condonation of shortage of attendance in that course by the condonation committee. Students whose attendance in a course is less than 65% or whose shortage in attendance has not been condoned will not be eligible to appear in the End-Semester Examination of that course and will be awarded grade ‘F’ in that course and all marks obtained in any component of the course-evaluation will stand cancelled. However, in case a student is repeating a course and the student has already fulfilled the attendance requirement in that course, he/she will not be detained due to shortage of attendance in that course during the repeating semester.

9. Examination and Evaluation (In lieu of Clause (9) of Chapter XV of the existing Academic Ordinances)

9.1 Components of Evaluation

Each course will be evaluated out of 100 marks. The courses will normally have the following components of evaluation:

(a) Theory courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course work</td>
<td>15</td>
</tr>
<tr>
<td>Mid-Semester Examination</td>
<td>25</td>
</tr>
<tr>
<td>End-Semester Examination</td>
<td>60</td>
</tr>
</tbody>
</table>
Laboratory courses including Seminar, Colloquium, Project, etc.
Course work 60 marks
End-Semester Examination 40 marks

However, for special academic reasons, some courses may have different weight for different components of evaluation from that given above. Such special reasons will be spelt out clearly in the curriculum.

9.2 Grading System

The combined marks obtained by a student in various components of evaluation of a course shall be converted into regular letter grades with their equivalent grade points as specified below:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>Outstanding</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>Very good</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>Good</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>Satisfactory (Minimum Pass Grade)</td>
</tr>
<tr>
<td>E</td>
<td>2</td>
<td>Unsatisfactory (Fail)</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>Detained due to shortage of attendance</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
<td>Incomplete/Absent in the End-Semester Examination</td>
</tr>
<tr>
<td>Z</td>
<td>0</td>
<td>Cancelled due to other reasons</td>
</tr>
</tbody>
</table>

The following marks ranges may ordinarily be used for the award of grades to the students in a course.

<table>
<thead>
<tr>
<th>Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 and above</td>
<td>A</td>
</tr>
<tr>
<td>60 and above but less than 75</td>
<td>B</td>
</tr>
<tr>
<td>45 and above but less than 60</td>
<td>C</td>
</tr>
<tr>
<td>35 and above but less than 45</td>
<td>D</td>
</tr>
<tr>
<td>Less than 35</td>
<td>E</td>
</tr>
</tbody>
</table>

Two grace marks may be awarded by the examiner for passing a course and one grace mark may be awarded by the examiner to elevate the grade. Any fraction in any component of evaluation should be rounded off to the next whole number.

The examiner(s) may propose higher or lower grade ranges depending upon the nature of the course and general performance of the students in the course, but the final decision rests with the Result Moderation Committee. However, the minimum passing grade ‘D’ should never be awarded if a student secures below 35 marks (including 2 grace marks) in a course.

9.3 Evaluation of a Graduating Course

A graduating course shall be evaluated on the basis of the End-Semester Examination component of the course alone. The student shall appear only in the End-Semester Examination of the graduating course. Grade D shall be awarded if the student concerned obtains 35 or more of the marks allotted to End-Semester Examination alone. In case the marks obtained are less than 35, grade E will be awarded. Two grace marks, however, will be awarded for passing the course.

9.4 Earned Credits (EC)

If a student passes a course by obtaining grade D or above he/she earns the credits assigned to that course.

9.5 Performance Indices

At the end of every semester a student’s performance will be indicated by Earned Credits (EC), a Semester Performance Index (SPI), and a Cumulative Performance Index (CPI). The SPI is the credit-weighted average of grade points of all courses registered during a semester and is computed as follows:
SPI = \((C_1G_1 + C_2G_2 + \ldots) / (C_1 + C_2 + \ldots)\)

Where \(C_1, C_2\ldots\) are the credits assigned to courses and \(G_1, G_2\ldots\) are the grade points earned in those courses.

The CPI is the credit-weighted average of grade points of all courses passed in all the semesters since admission.

9.6 Repetition of a Failed Course

If a student fails in a course his/her marks of all components of evaluation in that course will be cancelled. The student will have to register the course again or its alternative and will be required to appear in all components of evaluation afresh. No previous marks shall be used in any case.

9.7 Repetition of a Passed Course

A student may repeat a course to try to improve his/her grade in that course only once, provided that he/she has passed that course in a single attempt. In such case the student will have to register the course again and will be required to appear in all components of evaluation afresh. No previous marks shall be used in any case. For the purpose of calculating the SPI the recently obtained grade will be considered while for CPI the better of the two grades will be counted.

9.8 Conduct of Examinations

(a) The examiners for the End-Semester Examination of all theory courses will normally be the teacher(s) associated with the course. The Seminar, Colloquium courses will be examined by the teacher(s) associated with the course and one or more examiners from among the teachers of the department to be recommended by the BOS of the department concerned. The laboratory and project courses will be examined by the teacher(s) associated with the course and an external examiner not in the service of the university at the time of examination. In case the external examiner does not turn up for the examination, the Chairman of the department concerned, in consultation with the course in-charge, shall call another person to act as the external examiner, even from within the University, if necessary.

(b) The End-Semester Examination of all graduating courses shall be conducted simultaneously along with the End-Semester Examination of regular courses of the current semester examination.

9.9 Moderation Committees

(a) Question Paper Moderation Committee: There shall be a Moderation Committee of the concerned Department consisting of the following members to moderate the Question Papers of the End-Semester Examination.

(i) Chairman of the Department concerned – (Convener)
(ii) One senior teacher of the Department in each broad area of specialization (to be appointed by the BOS).

Note: The Paper Setter(s) may be invited, if necessary, to clarify the necessary details of the question paper.

(b) Result Moderation Committee: There shall be a Result Moderation Committee of the concerned Department consisting of the following members to moderate course-wise results of the End-Semester Examinations.

(i) Chairman of the Department concerned - (Convener)
(ii) One senior teacher of the Department in each broad area of specialization (to be appointed by the BOS).
(iii) Examiner(s) concerned.

The Result Moderation Committee will examine the result of each theory course and in case of an abnormal situation; it may take suitable corrective measures in consultation with the examiner(s). The examiner(s) will
place the evaluated answer scripts along with the brief solution and marking scheme before the Committee. In case of difference of opinion among the members of the Committee, the majority decision will prevail, in which the examiner(s) will not participate.

10. Degree Requirement

(a) A student who earns 200 credits subject to the break up in various course categories and fulfills such other conditions as may be mentioned in the curriculum will be awarded the degree of Bachelor of Technology. He/she must also pay all University dues as per rules. Moreover, there should be no case of indiscipline pending against him/her.

(b) If a student earns more credits than the minimum required for the award of degree, his/her CPI will be calculated by considering the best grades subject to fulfilling the criteria of required credits as specified in the curriculum.

11. Name Removal from the Rolls of the University and Mercy Appeal

11.1 Name Removal

The earned credits (EC) of every student will be checked at the end of even number of semesters and if the total credits earned by the student are less than the minimum required as given below, his/her admission to the B. Tech. program will be cancelled and his/her name will be removed from the rolls of the University.

<table>
<thead>
<tr>
<th>Check Point (No. of semesters after admission)</th>
<th>Minimum EC requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 semesters</td>
<td>0</td>
</tr>
<tr>
<td>4 semesters</td>
<td>25</td>
</tr>
<tr>
<td>6 semesters</td>
<td>50</td>
</tr>
<tr>
<td>8 semesters</td>
<td>80</td>
</tr>
<tr>
<td>10 semesters</td>
<td>110</td>
</tr>
<tr>
<td>12 semesters</td>
<td>140</td>
</tr>
<tr>
<td>14 semesters</td>
<td>200</td>
</tr>
</tbody>
</table>

11.2 Mercy Appeal

If the name of a student is removed from the rolls of the University as per provisions of clause 11.1 of these ordinances, he/she may appeal to the Vice-Chancellor stating the reasons for not being able to earn the required credits and the Vice-Chancellor, if he is satisfied with the reasons, may allow the continuation of admission of the student only once during the tenure of the program, extending the total duration of the program by two semesters, at the maximum, beyond 14 semesters, if required. Under no circumstances a student will be allowed to complete the program after the lapse of 16 semesters after admission.

12. Result

a) If a student passes all the examinations and fulfills all the requirements for the award of degree his/her result will be shown as “Graduated”.

b) The Division awarded to “Graduated” students will be based on CPI as given below:

- First Division (Honours) CPI $\geq 8.5$
- First Division CPI $6.5 \leq CPI < 8.5$
- Second Division CPI $< 6.5$

There shall be no formula for conversion of CPI or SPI into equivalent percentage of marks during the program. However, once the program is completed by a student and he/she is graduated, his/her final CPI will be converted into equivalent percentage of marks by the following formula:

$$y = \frac{(20x^3 - 380x^2 + 2725x - 1690)}{84}$$
Where y is the percentage of marks and x is the CPI.

(c) If a student earns more credits than the minimum required as given in the table in clause 11.1 before fulfilling the degree requirements, his/her result will be shown as “Continued”.

(d) If the name of a student is removed from the rolls of the University as per provisions of clause 11.1 of these ordinances his/her result will be shown as “Name Removed”.

(e) Ranks/Positions will be determined at the end of even semesters. Only those students who fulfill the following conditions will be eligible for ranks/positions:

   (i) They do not have any break in their studies;
   (ii) They have passed every scheduled course in first attempt;
   (iii) They have passed every course on time as per the curriculum;
   (iv) They have earned credits as per the schedule given in the curriculum;
   (v) They have not improved grade in any course after passing the course.

The students who violate any of the above conditions will not be awarded any rank/position. The ranks/positions will be determined on the basis of CPI.

13. Transitory Ordinance

Candidates admitted prior to the implementation of these Ordinances shall be governed by the Ordinances (Academic) under which they were admitted. Students who fail in the courses that are no more offered in these new ordinances and new curriculum will be allowed to pass the alternative courses, and in case there are no alternative courses, the old courses may be offered. For such candidates, any marks obtained earlier shall not be taken into account for passing the course(s) and they will have to obtain marks in all components of evaluation afresh. A student admitted previously may apply to the Dean through the Chairman concerned, to be governed by these ordinances. Such cases may be allowed on a case by case basis.
1. Explanations

1.1 Course Number

Every course has a course number consisting of 5 characters (minimum) and 6 characters (maximum). The first two characters are alphabets indicating the department that offers or coordinates the course; the third character is a numerical digit indicating the year of offering the course in the program; the fourth character is a numerical digit indicating the type of course; the fifth character is a numerical digit that does not indicate any particular thing; and the sixth character is optional.

(a) The first two alpha characters will mean the following:

- AC = Department of Applied Chemistry
- AM = Department of Applied Mathematics
- AP = Department of Applied Physics
- AR = Department of Architecture
- CE = Department of Civil Engineering
- CH = Department of Chemical Engineering
- CO = Department of Computer Engineering
- EE = Department of Electrical Engineering
- EL = Department of Electronics Engineering
- ME = Department of Mechanical Engineering
- PK = Department of Petroleum Studies
- EZ = Departments external to Z.H. College of Engineering & Technology

(b) The third character will be 1, 2, 3, or 4 indicating First Year, Second Year, Third Year or Fourth Year of the B. Tech. program.

(c) The fourth character will be interpreted as follows:

- 1-7 = Theory courses
- 8 = Courses such as Seminar, Colloquium, Field work, etc.
- 9 = Laboratory/Practical courses and Projects.

1.2 Faculty Number

Every student has a Faculty number consisting of 8 characters. The first two characters are numerical digits indicating the year of admission; the third and fourth characters are alphabets indicating the branch of the B. Tech. program; the fifth character is always “B” indicating B. Tech. program; the sixth, seventh and eighth characters are numerical digits that are for identifying a student of a particular batch.

a) The first two characters will be the right most two digits of the year of admission. Thus students admitted in 2011 will have the first two characters as 11.

b) The third and fourth characters will be interpreted as follows:

- CE = Civil Engineering
- EE = Electrical Engineering
- KE = Chemical Engineering
- LE = Electronics Engineering
- ME = Mechanical Engineering
- PE = Computer Engineering
- PK = Petrochemical Engineering

c) In case of change of branch after First year, a student’s faculty number will be changed as required.

1.3 Marks

xxx
a) The combined total marks obtained by a student in the course work and the mid-semester examination will be called Sessional Marks.

b) The marks obtained by a student in the end-semester examination will be called Examination Marks.

2. Conduct of Teaching

2.1 Course In-charge

Every course will be taught by one or more teachers. The BOS of the concerned department will allocate the teaching load to the teacher(s) and will also designate a course in-charge for each course. If more than one department is involved in the teaching of the course, the course in-charge will be from the coordinating department. The course in-charge will coordinate all the work related to attendance, course work, examination and evaluation. It is necessary that the students are informed about the course in-charge so that they may contact him/her about any problems regarding the course.

2.2 Display of Attendance, Marks etc.

It is essential that the attendance should be displayed to the students twice in a semester, once in the middle and then at the end of a semester by the teacher(s) concerned. The mid-semester marks should be displayed to students normally within 15 days of the examination. The total sessional marks should be displayed to the students before the beginning of the end-semester examinations. The course in-charge will ensure that the teachers associated with the course make such displays and, in case of complaints from the students in this regard, shall inform the Chairman of the concerned department about the problem.

2.3 Offering Courses

(a) Courses will be offered by the department concerned as per the schedule given in the relevant Curriculum. Departments may also offer a course in both the semesters even though it may be shown in a particular semester.

(b) Department Elective (DE) courses will be offered depending on the availability of the staff and other facilities and therefore any particular elective course may not be offered even though it may exist in the list of possible elective courses.

(c) The advisement for Open Elective (OE) courses in various departments will be based on the guidelines approved by the respective Board of Studies.

2.4 Syllabus

Each course will have a syllabus which will be distributed to the students. The teacher(s) concerned should ensure that some portion, beyond the syllabus, should also be covered in the class.

3. Correction of Errors

In case any error is detected in the marks recorded on the award list, the examiner(s) concerned shall make a request to correct the mistake to the Dean, Faculty of Engg. & Tech. through the Chairman of the concerned department, and shall attach relevant documentary evidence. A committee consisting of the following members shall take suitable remedial measures depending upon the merit of the case.

1. Dean, Faculty of Engg. & Tech. (Chairman)
2. Principal, ZH College of Engg. & Tech.
3. Chairman of the concerned department.
4. One senior member of the Faculty, not belonging to the concerned department, to be nominated by the Dean.

4. Examinations

4.1 Mid-Semester Examination
Mid-semester examination(s) of each course will be of one hour duration and will be conducted as per norms and schedule notified by the office of the Dean in each semester.

4.2 End-Semester Examination

End-semesters examination(s) of each theory course shall be of three hours duration and will be conducted as per norms and schedule notified by the Controller of Examination of the University on the advice of the Dean. The end-semesters examinations of laboratory/practical courses, and other courses such as seminar, colloquium, field work and project etc. shall be conducted as notified by the Dean/Chairman concerned.

4.3 Make-up Test

Students who miss the Mid-Semester Examination in a course due to illness or some other extra-ordinary compelling situation may contact the teacher(s) concerned of the course with the request to conduct a make-up test. The teacher(s) shall follow the guidelines in this regard approved by the Faculty from time to time. There shall be no make-up test/examination for end-semesters examinations.
COURSE STRUCTURE

Effective for Students admitted in the Session 2011-2012 and Later
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lecture (L)</th>
<th>Tutorial (T)</th>
<th>Practical (P)</th>
<th>Total Hours</th>
<th>Credits</th>
<th>Mid-Semester Exam (ME)</th>
<th>End-Semester Exam (EE)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM111</td>
<td>Mathematics-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>AM112</td>
<td>Mathematics-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>AP111</td>
<td>Applied Physics</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>AC111</td>
<td>Applied Chemistry</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>AP194</td>
<td>Applied Physics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>AC194</td>
<td>Applied Chemistry Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>EN101</td>
<td>English</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>EE111</td>
<td>Basic Electrical &amp; Electronics Engg.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>ME101</td>
<td>Basic Thermal Sciences</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>ME111</td>
<td>Applied Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>ME193</td>
<td>Engg. Graphics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>ME194</td>
<td>Manufacturing Process Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>CO191</td>
<td>Computer Programming Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>CE111</td>
<td>Environmental Studies</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>27</td>
<td>14</td>
<td>10</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

**FIRST/SECOND SEMESTER (AUTUMN/WINTER SEMESTER) 1 YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lecture (L)</th>
<th>Tutorial (T)</th>
<th>Practical (P)</th>
<th>Total Hours</th>
<th>Credits</th>
<th>Mid-Semester Exam (ME)</th>
<th>End-Semester Exam (EE)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM212</td>
<td>Mathematics-III</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE212</td>
<td>Civil Engg. Materials</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE213</td>
<td>Fluid Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE215</td>
<td>Engg. Geology</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE220</td>
<td>Quantity Survey</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE291R</td>
<td>Civil Engg. Materials Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>CE292R</td>
<td>Fluid Mechanics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>CE293R</td>
<td>Engg. Geology Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>8</td>
<td>6</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

**THIRD SEMESTER (AUTUMN SEMESTER) 2 YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lecture (L)</th>
<th>Tutorial (T)</th>
<th>Practical (P)</th>
<th>Total Hours</th>
<th>Credits</th>
<th>Mid-Semester Exam (ME)</th>
<th>End-Semester Exam (EE)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM212</td>
<td>Mathematics-IV</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE212</td>
<td>Structural Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE217</td>
<td>Construction Practice</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE218R</td>
<td>Surveying</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE219</td>
<td>Hydrology</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>CE286R</td>
<td>Engg. Geology Camp</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0*</td>
<td>1.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

**FOURTH SEMESTER (WINTER SEMESTER) 2 YEAR**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EZ291</td>
<td>Communication Skills Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE294R</td>
<td>Structural Mechanics Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE295R</td>
<td>Surveying Lab</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>CE311</td>
<td>Design of Concrete Structures-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE312</td>
<td>Soil Mechanics</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE313N</td>
<td>Environmental Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE384R</td>
<td>Survey Camp</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CE391R</td>
<td>Soil Mechanics Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE392R</td>
<td>Environmental Engg. Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>DE-I</td>
<td>Departmental Elective-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>DE-II</td>
<td>Departmental Elective-II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE315</td>
<td>Structural Analysis-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE316</td>
<td>Engg. Hydraulics-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE317</td>
<td>Transportation Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE318N</td>
<td>Design of Steel Structures</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE389</td>
<td>Colloquium</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>CE395R</td>
<td>Steel Design Practice Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE396R</td>
<td>Hydraulics Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE397R</td>
<td>Transportation Engg. Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE411</td>
<td>Design of Concrete Structures-II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE413</td>
<td>Foundation Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE488R</td>
<td>Professional Training</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CE491R</td>
<td>Concrete Design Practice Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE492R</td>
<td>Structural Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE494A</td>
<td>Project A</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>DE-III</td>
<td>Departmental Elective-III</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>OE-I</td>
<td>Open Elective-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE410</td>
<td>Construction Management</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE414</td>
<td>Engg. Hydraulics-II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE415</td>
<td>Irrigation Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE493N</td>
<td>Design of Irrigation works</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**FIFTH SEMESTER (AUTUMN SEMESTER) 3 YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE311</td>
<td>Design of Concrete Structures-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE312</td>
<td>Soil Mechanics</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE313N</td>
<td>Environmental Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE384R</td>
<td>Survey Camp</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CE391R</td>
<td>Soil Mechanics Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE392R</td>
<td>Environmental Engg. Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>DE-I</td>
<td>Departmental Elective-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>DE-II</td>
<td>Departmental Elective-II</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**SIXTH SEMESTER (WINTER SEMESTER) 3 YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE315</td>
<td>Structural Analysis-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE316</td>
<td>Engg. Hydraulics-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE317</td>
<td>Transportation Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE318N</td>
<td>Design of Steel Structures</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE389</td>
<td>Colloquium</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>CE395R</td>
<td>Steel Design Practice Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE396R</td>
<td>Hydraulics Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE397R</td>
<td>Transportation Engg. Lab</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**SEVENTH SEMESTER (AUTUMN SEMESTER) 4 YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE411</td>
<td>Design of Concrete Structures-II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE413</td>
<td>Foundation Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE488R</td>
<td>Professional Training</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CE491R</td>
<td>Concrete Design Practice Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE492R</td>
<td>Structural Lab</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CE494A</td>
<td>Project A</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>DE-III</td>
<td>Departmental Elective-III</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>OE-I</td>
<td>Open Elective-I</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**EIGHTH SEMESTER (AUTUMN SEMESTER) 4 YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE410</td>
<td>Construction Management</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE414</td>
<td>Engg. Hydraulics-II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE415</td>
<td>Irrigation Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CE493N</td>
<td>Design of Irrigation works</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
*Seminars, project works may be considered as practical.
* Courses based on field training involving one day to a month.

### List of Departmental Elective Courses

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credits</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>CW</th>
<th>ME</th>
<th>EE</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>CE421</td>
<td>Concrete Technology</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE425</td>
<td>Advanced Hydrology</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE427</td>
<td>Geo-Engineering of Rocks and Rock Mass</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE428</td>
<td>Dam Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE429</td>
<td>Industrial Pollution Control</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE430</td>
<td>Structural Analysis-II</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE432</td>
<td>Water Power Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE433</td>
<td>Advanced Highway Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE434</td>
<td>Bridge Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE438</td>
<td>Advanced Structural Analysis</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE441</td>
<td>Advanced Foundation Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE445N</td>
<td>Elements of Earthquake &amp; Wind Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

### List of Open Elective Courses

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credits</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>CW</th>
<th>ME</th>
<th>EE</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>OE</td>
<td>CE444N</td>
<td>Disaster Management</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>OE</td>
<td>CE481</td>
<td>Fundamentals of Environmental Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>OE</td>
<td>CE483</td>
<td>Water Resources &amp; Watershed Management</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

### Nomenclature:
- BS : Basic Science
- ESA : Engineering Science & Arts
- HM : Humanities
- DC : Departmental Core (Essential)
- DE : Department Elective
- OE : Open Elective

### Degree Requirements

<table>
<thead>
<tr>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>28</td>
</tr>
<tr>
<td>ESA</td>
<td>29</td>
</tr>
<tr>
<td>HM</td>
<td>10</td>
</tr>
<tr>
<td>DC</td>
<td>109</td>
</tr>
<tr>
<td>DE</td>
<td>16</td>
</tr>
<tr>
<td>OE</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200</strong></td>
</tr>
</tbody>
</table>
PROGRAMME SPECIFIC CRITERIA

The B. Tech. program in Civil Engineering has a strong focus in Mathematics, Sciences, Structural, Hydraulics, Environmental and Geotechnical areas to give student a sound education to prepare him/her as a Professional Civil Engineer. The curriculum specifications and faculty qualifications are in consonance with both criteria specified by ABET and ASCE.

In addition, our program curriculum is in consonance with the Model Scheme of instruction and syllabi for UG Engineering Degree Programmes proposed by All India Council for Technical Education (AICTE), New Delhi, October 2013.

The first two years include courses that deal with the principles of mathematics, physical and engineering sciences on which engineering concepts are based, as well as courses in humanities and social sciences and introductory courses in engineering and design. The last two years are devoted to developing the necessary technical competence, as well as the ability to apply the knowledge that the student has acquired to the design and synthesis of complex civil engineering projects. A year-long Project-based learning is the most important and essential parts of the curricula wherein students get hands on exposure to analyse and design live projects.

The entire curriculum is oriented to develop student’s ability of logical and critical thinking. Upon graduation the student will develop the capacity for professional growth, either by opting for higher studies or as a practicing professional engineer. A student may also use their academic background to venture in management, administration.

Specific criteria to be met under ABET/ASCE requirements are based on following aspects:

I. **Proficiency in mathematics, physics, chemistry, engineering sciences and humanities**

   The program curriculum ensures that all graduates will have proficiency in the following subjects by completing the indicated courses with a grade of D or better:

   - Mathematics through differential equations: [16 credits] AM 111, 112, 211, 212
   - Applied Physics: [6 credits] AP 111, 194
   - Applied Chemistry: [6 credits] AC 111, 194
   - Engineering Sciences: [6 credits] CE 111, 215, 286R, 293R; CO 191; EE 111; ME 101, 111, 193, 194
   - Humanities: [6 credits] EN 101, EZ 291

II. **Proficiency in four technical areas of civil engineering**

   The program gives emphasis for specialization in four major thrust areas in civil engineering; Structural, Hydraulics, Environmental and Geotechnical. The students are supposed to acquire proficiency in these four areas, by completing the following courses with a grade of D or better:

   - Structural Engineering: [32 credits] CE 212, 216, 217, 220, 311, 315, 318N and 411
   - Hydraulic Structures: [20 credits] CE 213, 219, 316, 414 and 415
   - Environmental Engineering: [4 credits] CE 313N
   - Geotechnical Engineering: [12 credits] CE 312, 317 and 413
III. Ability to conduct experiments and analyze / interpret data

All graduates shall have laboratory experience to develop the skills to analyze and interpret data efficiently in the major civil engineering areas, by completing the indicated courses with a grade of D or better:

- CE 216 Structural Mechanics
- CE 218R Surveying
- CE 291R Civil Engineering Materials Lab
- CE 292R Fluid Mechanics Lab
- CE 294R Structural Mechanics Lab
- CE 295R Surveying Lab
- CE 315 Structural Analysis-I
- CE 384R Survey Camp
- CE 391R Soil Mechanics Lab
- CE 392R Environmental Engineering Lab
- CE 396R Hydraulics Lab
- CE 397R Transportation Engineering Lab
- CE 415 Irrigation Engineering
- CE 492R Structural Lab
- CE 494A Project
- CE 494B Project

In addition, the following focus area-specific courses provide further opportunities for gaining experimentation, data analysis, technical presentation and managerial skills:

- CE 389 Colloquium
- CE 410 Construction Management
- CE 421 Concrete Technology
- CE 425 Advanced Hydrology
- CE 427 Geo-Engineering of Rocks and Rock Masses
- CE 428 Dam Engineering
- CE 429 Industrial Pollution Control
- CE 430 Structural Analysis-II
- CE 432 Water Power Engineering
- CE 434 Bridge Engineering
- CE 438 Advanced Structural Analysis
- CE 441 Advanced Foundation Engineering
- CE 444N Disaster Management
- CE 445N Elements of Earthquake & Wind Engineering
- CE 481 Fundamentals of Environmental Engineering
- CE 483 Water Resources & Watershed Management
- CE 488R Professional Training

IV. Ability to perform design
To gain proficiency in designing and analyzing components, processes, or elements, of structure by identifying different stages. The stages include problem identification followed by fixation of objective, selection of material, technology, preliminary design; detailed analysis and detailing before execution are integral part of all the courses and is well distributed throughout the curriculum, to emphasize design experience. Following courses take care of design aspect in four technical areas, which the students complete with a grade of D or better:

- **Structural Engineering:** [44 credits] CE 216, 311, 315, 318N, 395R, 411, 430, 434, 438, 491R, 494A and 494B
- **Environmental Engineering:** [20 credits] CE 313N, 429, 481, 494A and 494B
- **Geotechnical Engineering:** [30 credits] CE 312, 317, 413, 441, 494A and 494B

**CORE ENGINEERING SUBJECTS WITH DESIGN EXPERIENCE**

Civil Engineering is a society oriented profession that has long been in existence to serve the needs of mankind. It evolved with the advent of society and for increased mobility and convenience. The role of the civil engineer has always been one that deals primarily with public works: the planning, design, and construction of airports, buildings, transportation, bridges, irrigation, flood control, water supply and waste disposal systems. These civil engineering works not only manage our environment, but are very much part of the environment itself and have important social and economic impacts.

The most important objective of civil engineer is to design structures keeping in view utility, safety and cost. The emphasis in undergraduate civil engineering program is to impart basic knowledge and acumen towards designing. To achieve this goal various courses have been intentionally incorporated in the curriculum, starting from basic and engineering science courses and progressing through design intensive courses to culminate in project design course.

**Design in Structural Engineering focus area:**

The beginner course in this focus area is ME 111: Applied Mechanics, which is a combination of Strength of Material and Engineering Mechanics, where the students get a feel of strength associated with any material subjected to different kinds of deformations and gets a broad view of stability of a rigid body. The students are able to understand fundamental theories of stress, strain, and deflection of deformable bodies due to bending, axial force, torsion, and shear. The students are introduced to the procedures for applying these basic principles to the design of shafts and beams.

The first course is supplemented by Structural Mechanics theory & lab (CE216, CE294R) where students learn principles of strain energy which is the extremum principle of structural engineering. Another important principle of direct and bending stresses, eccentric loading is taught which is further applied in design of columns, voussoirs of Arch. The analysis of framed structure is imparted through Structural Analysis-I & II (CE315, CE430) course wherein the concept of force and displacement method and solution of equations are given by iterative as well as closed forms for use as design tools.

Our students are taught design paper in three stages: In first stage, they are taught design philosophy on empirical basis with deterministic load. In second stage, we teach some deterministic loading and ultimate load theory. In the final stage, the students are taught Limit State Method which is a probabilistic approach in material strength and loading.

The abovementioned stages are covered in Design of Concrete Structures-I (CE311) followed by Design of Concrete Structures-II (CE411). The students are also given exposure into steel structures through Design
of Steel Structures (CE318N) course where they apply Limit State Method for designing steel structures. The students are trained through design tutorials in Steel Design Practice Lab (CE395R) and Concrete Design Practice Lab (CE491R) courses. Finally they draw and detail the design problem by hand sketching as well as through AutoCAD software.

The students are given freedom to choose their final year Project (CE494A/B) in Structural Engineering based on their knowledge gained through the above courses and design different types of structural systems including residential and commercial buildings, bridges, flyovers and different types of tanks. In this program, our students are exposed and encouraged to use modern engineering softwares like STAAD Pro, ETABS, SAP etc.

Design in Hydraulic Structures focus area:

Water being an important natural resource, due credence is given to water resource conservation and its optimum utilization by mankind in terms of civil water supplies and irrigation potential in civil engineering. Various hydraulic structures are made to store; raise water level and its distribution through open and closed channels. This warrants proper understanding of hydrology, hydraulic systems and fluid mechanics. There are some natural disasters notably flood, storm, cloud burst where immense amount of water accumulate in a very short time span leading to deluge hence require hydraulic systems to minimize its effect.

The introduction to water system and mechanics involved therein is first studied through course Fluid Mechanics (CE213), where students learn the fundamentals of fluid flow, apply continuity and energy equations to ‘design’ components of hydraulic systems; for e.g. in sizing the pipes, estimating pump capacity etc under given conditions. They also get an opportunity to conduct laboratory tests on related topics through lab course on Fluid mechanics (CE292R). The students are exposed to various natural repositories of water, their movement and various hydrological processes in Hydrology (CE219). They are also taught to measure various hydraulic parameters to be applied in designing of hydraulic structures. These courses are followed by Engineering Hydraulics I & II (CE316, CE414), where the students are exposed to various hydraulic parameters, their governing equations and applications in real life problems. The Hydraulic lab course (CE396) gives an idea of understanding abovementioned hydraulic entities through experimentation.

Following these courses, students undergo design intensive course of Irrigation Engineering (CE415) and Design of Irrigation works (CE493N), where they learn efficient and proper designing and detailing of some typical irrigation structures i.e. Earthen canals, Lined Canals, Stable alluvial channel, Canal regulation structures, Cross drainage works, Diversion headworks etc. The importance and effect of uplift pressure in the design of hydraulic structures on permeable soils is duly emphasised keeping in view sustainable design of hydraulic structures on permeable foundations. Due importance is given to proper detailing in the drawings of hydraulic structures.

Finally, students undertake a Project (CE494A/B) to design structures for flow measurement, regulation, drainage, energy dissipation, and conveyance. Students apply rainfall, runoff, and flow estimation methods learnt in CE 219, to develop and establish design criteria based on static and dynamic loads, evaluate adequacy based on structural stability, capacity, precision and economic performance. In this program, our students are exposed and encouraged to use modern engineering softwares like STAAD Pro, MIKE 11, QUAKE11 etc.

Design in Environmental Engineering focus area:

The beginner course in this focus area is Environmental Studies (CE111), which deals with ecology, natural processes and chemistry involved in different aspects of environment. This course trains the students about the water, wastewater characteristics, purification processes, both natural and advanced techniques. This course also offers a basic knowledge about importance of the solid waste and its
management and air pollution control. This course builds up the basic fundamental background for the higher environmental engineering courses offered in civil engineering department.

The first course is supplemented by Environmental Engineering theory and laboratory (CE313N, CE392R) course where students are made conversant about the environmental pollution problems related to land, air and water. In this course, students learn about the design of collection and distribution of domestic wastewater and different techniques of onsite treatment of sewage. They are imparted knowledge for designing of wastewater treatment processes (Physical, Chemical and Biological) including the latest state of the art technologies (Sequencing Batch Reactor, Upflow Sludge Blanket Reactor, and Advanced Oxidation Process, Low cost treatment systems, Stabilization ponds, lagoons, wetlands Septic tank, Sludge Treatment). A brief idea of solid waste collection, its sources, characteristics and different methods of its disposal is also given in this course. In the laboratory part, the experiments are designed in such a way that the students thoroughly understand the practical utility of different water and wastewater analysis and treatment system design.

In addition to the above courses, department offers departmental elective course titled Industrial Pollution Control (CE429) for the civil engineering students who wish to learn about the role of science and engineering in Industrial Pollution Control. In this course, students learn about the severity of the industrial pollution and design processes involved in the treatment of wastewater, and control of air pollution. They are taught about pollution abatement in major industries: Textile, Paper and Pulp, Steel, Sugar, Distillery, Petroleum Refinery. Another part of the course focuses on Air pollution control, methods for removal of particulates and gaseous pollutants, design principles for controlling devices.

To impart fundamental training and knowledge about this coveted field of engineering & sciences for students of other departments as well, the department offers open elective course titled Fundamentals of Environmental Engineering (CE481). This course develop basic understanding about the pollution control measures for water, air and land coupled with application in the industry of any type. For the interdisciplinary nature of this course, the role of microbiology in environmentally relevant processes including bioremediation of pollutants, Mass balance and energy balance approach, Kinetics, Steady-State Condition for designing of different treatment unit is being taught in this course.

In the final year, students undertake their final year project (CE494A/B) in Environmental Engineering where they identify and select the relevant environmental problems and then appropriately make use of the laboratory equipments for the testing and analysis of water/wastewater, solid waste, air etc according to their topic. During their project, they understand the limitations of different technologies involved in the solution of environmental problems. On that basis they design there experimental setup and fabricate different type of lab scale reactors in case of wastewater treatment system and analyse their experiments.

**Design in Geotechnical Engineering focus area:**

Geotechnical Engineering includes the study of mechanical behavior of geomaterials (soils and rocks), in relation to design and construction of civil engineering structures such as building foundations, retaining structures, embankments and excavations. Students learn to analyse and design structural foundations, assess slope stability of natural and man-made slopes with emphasis on numerical and limit equilibrium techniques, in addition to natural and man-made hazard mitigation, advanced techniques for site and material characterization, constitutive modeling of natural materials, design of pavement systems, and geo-environmental assessment and remediation.

The first course in this focus area is Engineering Geology (CE215), which provides the application of the science of geology to the understanding of geologic phenomena and the engineering solution of geologic hazards and other geologic problems for society. This course is well supplemented by Engineering Geology Lab (CE293R) and field training course, Engineering Geology Camp (CE286R). In this course, students acquire the basic background and laboratory skills required for Soil Mechanics and Soil Mechanics Lab (CE312, CE391R), where students learn the main concepts of soil mechanics and soil
engineering as they relate to civil engineering projects, basic soil testing methods and interpretation of the engineering properties of soils.

In addition to the above courses, Transportation Engineering and Transportation Engineering Lab (CE317, CE397R) courses are being taught at the third year level which applies the knowledge gained in the above courses for pavement materials design and testing.

Foundation Engineering (CE413) course at the seventh semester level applies the knowledge gained in previous courses to the analysis and design of shallow and deep foundations in diverse soil profiles and site conditions, and the calculation of settlements and lateral earth pressures in addition to slope stability analysis techniques for cohesive and cohesionless soils.

A departmental elective course is offered at the eighth semester level titled ‘Advanced Foundation Engineering’ (CE441) which takes into account the analysis and design of pile, under-reamed, well foundations and special case of foundations on expansive soils in addition to wave propagation analysis. Another departmental elective course ‘Geo-engineering of Rock and Rock Masses’ (CE427) is offered to students who wish to broaden understanding of earth materials as engineering materials and expand their knowledge base to include the engineering properties and characteristics of rocks. In this course, the students learn to apply knowledge for designing rock slopes, rock foundation, underground excavations, construction and rock support systems.

Finally the students select their Project (CE494A/B) in Geotechnical Engineering in which they work in groups to perform geotechnical investigations in the area but not limited to Geosynthetics, Ground Improvement, Transportation Engineering Projects etc. with the help of latest equipments and geotechnical softwares like PLAXIS, FLAC, GEO5, GEOSLOPE, ABAQUS etc.
COURSE SYLLABI
# Basic Sciences Courses:

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Physics</td>
<td>AP111</td>
<td>Applied Physics</td>
<td>BS</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

## Course Assessment Method
1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

## Course Objective
To equip the student with a strong understanding of the fundamentals of physics so as to enable him/her to apply it to his/her field of study.

This course should enable the student to:
1. Explain the behaviour of the physical world around him/her
2. Apply the concepts of physics in his/her field of study
3. Relate the concepts of physics to the advancement of technology.
4. Understand and relate the different phenomena in the world.
5. Approach problems, predict their results in advance, and solve them in quantitative and qualitative manner.
6. Gain a broader understanding of other sciences.

## Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Recognize and present real life examples of the aforementioned concept and interrelate some of them.
2. Describe the link between physics and the technology.
3. Identify technological applications of some of the aforementioned concepts.
4. Describe how he/she can harness the benefits of some of the aforementioned concepts to his/her area of specialization.
5. Understand the professional and ethical responsibilities of the subject.
6. Communicate effectively while speaking, employing graphics and writing.

## Topics Covered
**Unit 1**  
*Masers and Lasers:* Basic principle, Einstein coefficients for Induced absorption, Spontaneous emission and Induced emission, Ammonia maser and its applications, Ruby and He-Ne Lasers, Semiconductor laser, Spatial and temporal coherence, Characteristics of lasers and its applications based on these characteristics (such as in Industry, Science, Medicine, Communications, Surveying, Holography, Fusion reactors, Isotope separation, etc.).

*Fibre Optics:* Basic principle, Fibre construction and dimensions, Light propagation in fibres, Numerical aperture of the fibre, Step index and graded index fibres, Signal distortion in optical fibres, Transmission losses, Light wave communication in optical fibres, Fibre optics in medicine and industry.

**Unit 2**  
*Semiconductors:* Elemental and compound semiconductors, Energy bands, Direct and indirect semiconductors, Electrons and holes, Effective mass, Intrinsic material, Extrinsic material, Fermi level, Electron and hole concentration at equilibrium, Temperature dependence of carrier concentrations, Compensation and space charge neutrality, Conductivity and mobility, Hall effect in semiconductors.

*Superconductivity:* Zero resistivity, Meissner effect, Type I and Type II Superconductors, High...
temperature superconductors, BCS theory (qualitative), Josephson effect, SQUIDS.

**Unit 3**  
*Particles and Waves:* Mechanism of X-ray production (continuous and characteristic X-rays, Duane-Hunt limit), Compton effect, Pair production, Phase and group velocities, Uncertainty principle.

*Quantum Mechanics:* Introduction to quantum mechanics, Wave function, Conditions necessary for physically acceptable wave function, Probability density and probability, Schrödinger equation (Time dependent form and Steady state or time independent form), Eigen values and eigen functions, Expectation values, Particle in a box (Infinite square potential well), Tunnel effect (qualitative).

**Unit 4**  

*Nuclear Physics:* Q-value and threshold energy of nuclear reactions, Cross section of a nuclear reaction and reaction rate, Breeder reactors, Fusion reactors, Nuclear detectors (names and general working principle), Gas filled detectors, Scintillation detectors.

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Applied Physics</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Regular Lab. Assignments (42% record book + 18% viva-voce = 60%)
2. End Semester Examination (40%)- 2 Hour

**Course Objective**

This course should enable the student to:
1. Build an understanding of the fundamental concepts with the help of experiments.
2. Familiarize the student with the various experiments of the physical world around him/her.
3. Apply the concepts of physics in his/her field of study.
4. Relate the concepts of physics to the advancement of technology.
5. Allow the student to gain expertise in design and maintenance of experiment setup.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Recognize and present real life examples of various experiment performed.
2. Describe the link between physics and the technology.
3. Understand and explain data analysis and identify technological applications of the experiments.
4. Describe how he/she can harness the benefits of some of the experiments to his /her area of specialization.
5. Understand the professional and ethical responsibilities of the subject.
6. Communicate effectively while speaking, employing graphics and writing.

**Topics Covered/List of Experiments**

1. To determine the moment of inertia, \( I \) of a flywheel about its axis of rotation.
2. To determine resistance per unit length, \( \sigma \) of a Carey Foster’s Bridge wire and hence to find the difference between the two nearly equal unknown resistances.
3. To determine the modulus of rigidity of the material of a wire, \( \eta \) by statical (vertical) method.
4. To determine the refractive index, \( \mu \) of the material of a prism for parrot green line in the mercury spectrum.
5. To study the variation of semiconductor resistance with temperature and hence to find the energy-gap, \( E_g \) of the semiconductor.
   a) To study the V-I and power characteristics of a solar cell and also to determine its fill factor.
   b) To study the current versus voltage characteristics of two light emitting diodes (LED) and hence to determine their cut in voltages.
6. To determine the diameters of three thin wires with the help of a He-Ne Laser.
7. To determine the coefficient of thermal conductivity, \( K \) of rubber in the form of a tube.
8. To convert a Weston type galvanometer into an ammeter (ranges 5, 10 and 15 A) and a voltmeter (ranges 5, 10 and 15 V).
9. To determine the wavelength, \( \lambda \) of yellow line of shorter wavelength in the mercury spectrum with plane transmission grating.
10. To determine the specific rotation, \( \alpha_t \) of cane sugar solution in water using a biquartz polarimeter.
11. To calibrate a given thermo-couple with the help of a potentiometer.
12. To find the operating voltage of a G.M. counter and to determine the absorption coefficient, \( \mu \) of copper for gamma rays from \(^{137}\)Cs source.
13. a) To draw the graph between various values of capacitance and the corresponding frequencies of a given oscillator and to determine the value of unknown capacitance by using Lissajous Figures.
14. b) To draw the graph between various values of inductance and the corresponding frequencies of a...
given oscillator and to determine the value of unknown inductance by using Lissajous Figures.
15. To determine Hall coefficient, $R_H$ and majority carrier concentration of a given semiconductor sample.

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prof. D. S. Srivastava &amp; Dr. Ameer Azam, Laboratory Manual of Applied Physics Experiments, AMU, Aligarh</td>
</tr>
<tr>
<td>2. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Applied Chemistry</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments & Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**

To impart the knowledge of applications of chemical sciences in the field of engineering and technology

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Understand the basic knowledge of methods of chemical analysis and the instrumentation involved
2. Understand water treatment procedures for municipal and industrial uses
3. Understand about solid, liquid and gaseous fuels
4. Understand about lubricants, types and their applications
5. Understand about corrosion and techniques to control corrosion
6. Understand about polymers and their applications

**Topics Covered**

**Unit 1 Methods of Chemical Analysis:** Introduction to chemical analysis, Classification, Qualitative and gravimetric analysis, (quantitative analysis), Principle of gravimetry. The steps involved in gravimetric analysis, with special emphasis on precipitation, Digestion, Favorable conditions for precipitation, Von-Wiemann ratio, Types of precipitates, Impurities in precipitates and their minimization. Volumetric Analysis, Titration, Titrant, Analyte Basic requirements of titrimetric method. Primary and Secondary standards, Basic requirements of primary standard. Types of titrations, Acid-Base Titration (strong acid versus strong base, pH Titration curve) Redox titration (Iodimetry, Iodometry), Precipitation titration (Silver nitrate versus sodium chloride), Chelometric titration (Ca$^{2+}$/Mg$^{2+}$ versus EDTA). Absorption Spectrophotometry, Beer and Lambert’s law (definition and units of terms involved, deviation from Beer Lambert’s law, numerical problems), block diagram of single beam of UV – Visible Spectrophotometry. Definition of chromatography, Stationary and mobile phases, Classification of chromatography on the basis of physical mode and mechanism (adsorption, partition, size exclusion and ion exchange), RF Value.

**Unit 2 Treatment of Water for Municipal and Industrial Use:** Uses of water for municipal and industrial purposes, Sources of water, Impurities in water, Requirements of water for municipal use, Municipal water treatment methods, Plain sedimentation, Sedimentation with coagulation and filtration. Disinfection, Requirements of a good disinfectant, Types of disinfecting agents (Bleaching powder, Liquid chlorine, Ozone, UV radiations and Chloramine), Break point chlorination, Advantages of break point chlorination, super chlorination and dechlorination. Requirements of water for industrial use, Hardness of water, Units of hardness, Calculation on hardness, Theories of estimation of hardness by soap and EDTA methods. Boiler defects (Sludge and scale formation, Priming and foaming), Boiler corrosion and caustic embrittlement (Causes and prevention), Removal of hardness, Lime-soda process, Zeolite process, Ion-exchange process. Advantages and limitations of the process, Calculations based on lime-soda process.

**Unit 3 Fuels and Combustion:** Definition of fuels, Classification of fuels, Calorific value and its determination by bomb calorimeter, Dulong’s formula. Coal, Coal analysis (Boximiate and ultimate analysis), Significance of constituents of coal petroleum, Classification and important
fractions of petroleum and their uses (Petrol, Diesel, Lubricating oils), Synthetic petrol (Synthesis by polymerization, by cracking, by Fisher Tropsch process, by Bergius process), Gaseous fuels (CNG, LPG), Advantages and disadvantages of gaseous fuels, Combustion calculations based on solid and liquid fuels.

Unit 4 **Lubricants and Lubrication**: Definition and classification of lubricants, Functions of lubricants, Lubrication (Types of lubrication and their mechanisms). Liquid lubricants (Mineral oils, Fatty oils, Compounded oils and Silicone fluids), Greases (Types of greases and conditions of their use, Testing of greases, Solid lubricants and conditions of their use. Testing of liquid lubricants (Viscosity and viscosity index, Flash and fire points, cloud, pour and setting points, Saponification value, Aniline point), Selection of lubricants (Cutting tools, Internal combustion engine, Transformer, Refrigerators).

Unit 5 **Corrosion and its Prevention**: Definition, Significance (Economic aspect), Classification of corrosion. Dry corrosion, mechanism of dry corrosion, Types of oxide film, Pilling Bedworth rule. Electrochemical corrosion, mechanism of electrochemical corrosion, Factors influencing corrosion rate. Electrochemical series and Galvanic series, Corrosion control methods (proper design, important designing principles, selection materials, cathodic protection, metallic coatings (galvanizing, tinning), Organic coatings, types, Paints (Constituents of paints, Drying mechanism of oil).

Unit 6 **Polymers**: Definition and classification of polymers (On the basis of origin, synthesis, thermal response, physical state, applications, chemical structure). Polymerization (Addition and Condensation), Mechanism of free radical addition polymerization of vinyl chloride, Difference between thermoplastics and thermosetting plastics. Thermoplastics (Preparation, properties and uses of PE, PVC, Nyons, PTFE). Thermosetting plastics (Preparation, properties and uses of bakelite, polyesters). Elastomers (Preparation, properties and uses of NR, BUNA rubbers), vulcanization.

**Text Books and/or Reference Materials**

2. Quantitative Analysis by R. A. Day and A. L. Underwood
3. A Text Book of Engineering Chemistry by S. S. Dara, S. Chand & Co., New Delhi (India)

**Additional Learning Source**

1. Engineering Chemistry by B. K. Sharma, Krishna Prakashan Media (P) Ltd., Meerut (India)
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Chemistry</td>
<td>AC194</td>
<td>Applied Chemistry Lab</td>
<td>BS</td>
<td>None</td>
<td>Theory</td>
<td>2</td>
<td>0 1 2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Regular Lab. Assignments (42% record book+18% viva-voce = 60%)
2. End Semester Examination (40%)- 2 Hour

**Course Objective**
To train the students for the applications of the chemical sciences in the field of engineering and technology

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Understand the basic methods of chemical analysis and the instrumentation involved
2. Estimate the hardness of water
3. Carry out the proximate analysis of coal and grade the coal for industrial purposes
4. Estimate the drop point of grease and its applications
5. Study and explore the nature of the corrosion and its control
6. Know about the determination of the molecular weight by viscometer

**Topics Covered/List of Experiments**
1. Determine total, permanent and temporary hardness of water in ppm by versenate method
2. To determine the amount of dissolved oxygen in water in ppm units
3. To determine the cloud point, pour point and setting point of an oil
4. To determine the percentage of available chlorine in the given sample of bleaching powder
5. To carry out proximate analysis of the given sample of coal
6. To determine the saponification value and percentage of fatty oil in the given sample of compounded oil
7. To determine the aniline point of a given sample of an oil
8. To determine the relative viscosity of an oil by redwood viscometer and to study the variation of viscosity with change in temperature
9. To demonstrate and explore the electrochemical nature of aqueous corrosion. To study the electrochemical methods of corrosion control
10. To determine the flash point of an oil by Abel’s and Pensky Marten’s apparatus
11. Determination of iron in a given sample of water with 1, 10 phenanthroline by spectrophotometry

**Text Books and/or Reference Materials**
1. Lab Manuals provided by the Department.

**Additional Learning Source**
1. Web
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Mathematics</td>
<td>AM111</td>
<td>Mathematics-I</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

To learn the fundamental concepts of matrices, differential and integral calculus, the theory of differential equations, applications.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Apply tools of the theory of matrices to relevant fields of Engineering.
2. Understand curve tracing and regions between different curves.
3. Expand important mathematical functions in power series and their applications.
4. Apply tools of integration to find length, surface area and volume.
5. Express real life problems into mathematical models using differential equations and analyse their solutions.

**Topics Covered**

Unit 1 Rank of a matrix with applications to consistency of a system of linear equations, eigen-values and eigen vectors of a matrix, Caley-Hamilton theorem.

Unit 2 Asymptotes and simple curve tracing. Successive differentiation, Leibnitz’s theorem, Taylor and Maclaurin series with remainder terms.

Unit 3 Applications of integration to lengths of curves, surfaces and volumes of solids of revolution.

Unit 4 Solution of exact differential equations, linear differential equations of second and higher order with constant coefficients, homogeneous differential equations, simultaneous linear differential equations, applications to physical problems.

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Mathematics</td>
<td>AM112</td>
<td>Mathematics-II</td>
<td>BS</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

To learn partial differentiation, multiple integration, polar forms of conics, various forms of general equation of second degree and its tracing, applications.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Understand the theory of functions of several variables and its applications
2. Understand double and triple integrals and use it to find surface area and volume
3. Learn various forms of general equation of second degree and its tracing
4. Understand polar forms of conics

**Topics Covered**

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Partial differentiation, Euler’s theorem, total differential, small errors, change of variables, Jacobians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 2</td>
<td>Taylor series of functions of two variables, approximate calculations, maxima and minima of functions of two variables, Lagrange’s multipliers</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Double and triple integrals, change of variables, change of order of integration, applications to area and volume</td>
</tr>
<tr>
<td>Unit 4</td>
<td>General equation of second degree, tracing of conics, introduction to polar form of conics</td>
</tr>
</tbody>
</table>

**Text Books and/or Reference Materials**


**Additional Learning Source**

**Applied Mathematics**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM211</td>
<td>Mathematics-III</td>
<td>BS</td>
<td>AM 111, AM 112</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)  
2. Mid-Semester Examination (25%) - 1 Hour  
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

To learn vector calculus, complex analysis, boundary value problems represented by partial differential equations.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Apply tools of vector differentiation and vector integration in engineering disciplines.
2. Understand and apply fundamental concepts of complex functions and complex integration to various problems.
3. Solve and interpret the solutions of one dimensional heat, and wave equations and two dimensional Laplace equation.

**Topics Covered**

- **Unit 1** Vector differentiation: scalar fields, gradient of a scalar field and its physical significance, vector fields, divergence and curl of a vector field and their physical significance, solenoidal and irrotational fields, determination of potential functions.
- **Unit 2** Vector integration: line integrals, conservative fields, surface and volume integrals, Gauss divergence theorem, Stokes’ theorem, Green’s theorem in a plane, applications.
- **Unit 3** Functions of a complex variable, analytic functions, Cauchy-Reimann equations, integration of functions of a complex variable, line integrals, Cauchy’s theorem, Cauchy’s integral formula.
- **Unit 4** Formation of partial differential equations, concept of boundary value problems, solution of two dimensional Laplace equation in Cartesian coordinates, solution of one dimensional heat and wave equations by the method of separation of variables.

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Mathematics</td>
<td>AM212</td>
<td>Mathematics-IV</td>
<td>BS</td>
<td>AM 111 AM 112</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

To learn numerical techniques for system of linear equations, non-linear equations, interpolation problems, numerical integration, numerical solution of differential equations and Laplace transforms.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply numerical methods to solve system of linear equations and non-linear equations
2. Find approximations using interpolation/extrapolations of different problems
3. Find numerical integration and numerical solutions of differential equations
4. Use Laplace transforms method and find the solution of differential equations

**Topics Covered**

Unit 1 Errors, solution of system of linear equations by Gauss elimination and Gauss-Seidel methods, solution of a nonlinear equation by general iteration and Newton Raphson methods, applications of Newton-Raphson method, finite difference operators and tables, detection of errors/missing values.

Unit 2 Newton’s forward and backward interpolation formulae for equal intervals, Newton’s divided difference and Lagrange’s interpolation formulae for unequal intervals, numerical differentiation, general quadrature formulae: Trapezoidal, Simpson’s and Weddle’s rules.

Unit 3 Gaussian quadrature, numerical solution of initial value problems by Taylor series, Euler’s, modified Euler’s and Runge-Kutta fourth order methods, solution of two point boundary value problems by finite difference method.

Unit 4 Laplace transforms, shifting theorems, transforms of derivatives and integrals, differentiation and integration of transforms, inverse transforms, and applications to single and system of linear differential equations.

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>EN101</td>
<td>English</td>
<td>HM</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

To develop reading, writing, communication and presentation skills.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Develop reading and writing skills.
2. Develop comprehension and interpretative skills.
3. Communicate one’s point of view in both written and verbal formats with clarity and grammatically correct language.
4. Express themselves clearly and appropriately in social and professional fields and strengthen professional etiquette.
5. Develop effective communication and presentation skills so as to maximize their scope for employability.
6. Enhance attitude for observational and analytical learning.

**Topics Covered**

Unit 1 Comprehensive questions, summary type as well as short answer type and questions on vocabulary for 10 passages of “Basic Scientific English” by Ewer and Latorre.

Unit 2 Comprehensive questions, summary type or short answer type from “Animal Farm” by G. Orwell.

Unit 3 Comprehensive questions, summary type or short answer type from “The Time Machine” by H. G. Wells.

Unit 4 Note taking, note making exercises, report and precise writing exercises.

Unit 5 Grammar, Composition and Spoken English.

**Text Books and/or Reference Materials**

2. George Orwell, “Animal Farm”.

**Additional Learning Source**

1. Web
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>EZ291</td>
<td>Communication Skills Lab</td>
<td>HM</td>
<td>None</td>
<td>Lab</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work: 60 Marks (60%)
2. End Semester Exam: 40 Marks (40%)

**Course Objective**

To develop communication and presentation skills using modern tools.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Analyze and apply the basic concepts of communication effectively.
2. Develop written and spoken communication skills.
3. Able to present their ideas rationally and logically.
4. Use modern communication tools for effective communication and presentation.
5. Describe the importance of constructive feedback for consistent self-development.
6. Communicate one's point of view with clarity duly attributing courtesy and formality to their conveying.
7. Engage in debates, group discussions and personal interviews.
8. Deliver oral presentation and seminars confidently.

**Topics Covered**

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Writing Official Letters: Basic principles, format and type: employment letters, placing orders enquiry and response letters, letters of complaint and apology, persuasive letters, curriculum vitae.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 2</td>
<td>Business Working: (a) Glossary of business terms (b) Drafting business messages: memos, telexes, e-mails, press notice references, tenders and bids, employment advertisements.</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Academic Writing: (a) Note-making and note-taking, abstracting, use of graphics (tables and free diagrams) preparing bibliography. (b) Writing academic papers and reports</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Oral Communication in Business Setup: Attending interviews, telephonic conversation, reception of visitors, holding meetings.</td>
</tr>
<tr>
<td>Unit 5</td>
<td>Oral Communication in Academic Setup: Participating in group discussions, Presenting prepared papers and reports, Seminar Strategies.</td>
</tr>
</tbody>
</table>

**Text Books and/or Reference Materials**

1. Model Business Letters by L. Gartside
2. Modern Business Correspondence English for Business Studies by L. Gartside
3. Notes and Handouts

**Additional Learning Source**

1. Web
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE410</td>
<td>Construction Management</td>
<td>HM</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**
1. To make student conversant with the concepts and importance of the subject of construction management
2. To make student capable, of preparing work break down structure along with network analysis like CPM and PERT.
3. To make student conversant with the concept of materials management and human resource management

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Develop a management system, incorporating constraints of time, cost, social, legal and ethical aspect of various phases of project life cycle.
2. Adapt oneself in team work and can interact with the persons of diverse skills and can freely communicate with fellow engineers and co-workers effectively.
3. Understand the values and ethics of professional practice.
4. Appreciate technological breakthrough and can notice the changes in practice and society.
5. Learn by observation and inference philosophy in all walks of life.
6. Apply knowledge of management directly in engineering and management professional practice.

**Topics Covered**

Unit 1  Financial analysis, cost of project, means of finances, planning the means of finances, depreciation, P W D account
Unit 2  Resource management, basic concepts, labour requirements, labour productivity, site productivity, non productive activities, equipment management, materials management
Unit 3  Factors affecting selection of construction equipment, brief description of bulldozers, scrapers, concrete mixers and sprinklers
Unit 4  Introduction to C P M, critical path, study of various floats, construction of networks, event, activity time computations, project time evaluation
Unit 5  Cost control for normal and crash time networks, probability of completion of project based on PERT time estimates, Linear programming-simplex method

**Text Books and/or Reference Materials**
2. Purifoy, “Construction Planning Equipments and Methods”, Mc Graw Hill, Tokyo, Japan

**Additional Learning Source**
1. Newspaper
2. Internet
3. Information available on various websites of professional organizations like RIBA, CII
Course Assessment Method
1. Assignments and Oral Quizzes (10%+5%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

Course Objective
The objective of this course is to set a firm and solid foundation in Electrical & Electronics Engineering with strong analytical skills and conceptual understanding of theorems and analysis methods in electrical and magnetic circuits, electronic devices, circuits, measuring instruments. The course will familiarize students with various motors, transformers, power generation system.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Analyse electrical and magnetic circuits with moderate complexity applying fundamental laws and theorems in steady-state as well as transient operation
2. Analyse AC circuits using phasors
3. Converse with transformers, motors, measuring instruments
4. Understand various methods of electrical generation
5. Identify schematic symbols and understand the working principles of electronic devices e.g. Diode, Zener Diode, LED, BJT, JFET and MOSFET etc
6. Understand the working principles of electronic circuit’s e.g. Rectifiers, Amplifiers and Operational Amplifiers etc.
7. Understand methods to analyse and characterize these circuits.

Topics Covered
Part A

Unit 1 Circuit and Transformers: Review of dc circuits and theorems, 1-phase circuits, superposition theorem, thevenin’s theorem and norton’s theorem for ac circuits, RLC series and parallel circuits, 3-phase balanced ac circuits.
Magnetic circuits, magnetization curve, hysteresis & eddy current effect/losses.
Transformer construction, equivalent circuit, calculation of losses and efficiency.

Unit 2 Introduction to electrical machines, instruments and power system: 3-phase induction motor and 1-phase induction motors.
Basic elements of an instrument: MC, MI instruments, dynamometer wattmeter, digital energy meter.
Elements of power system, layout of thermal, hydro, nuclear and gas plants.
Introduction to renewable energy sources and recent trends in generation.

Part B

Unit 3 Diode and BJT: Terminal characteristics of diodes, diodes models; Ideal, constant voltage and piecewise linear, load line concept, Diode applications; Rectifier, logic gates, Zener diode; Operation, characteristics, voltage regulation, Bipolar Junction Transistor; Construction,
operation, configurations, characteristics of common emitter configuration, DC load analysis.

Unit 4  MOSFET and OpAmp: Introduction to MOSFET; Depletion MOSFET construction, operation, Enhancement MOSFET construction, Operation, amplifiers, Operational Amplifiers; equivalent circuit, ideal behavior, open loop and closed loop concept, concept of virtual short, simple Opamp applications; Unity gain amplifier, inverting, non-inverting, integrator, differentiator, subtractor, summer.

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**

1. To have the basic concepts of thermal sciences and their application to in formulating the thermal engineering problems.
2. To have a good understanding of first and second laws of thermodynamics and will be in a position to fully understand the analysis to be taught at the higher levels.
3. To be in a position to check the feasibility of proposed processes and cycles using the ideas of second law of thermodynamics and entropy.
4. To develop the understanding of basic principles of heat transfer and related simple problems.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the basic concepts of units and dimensions, systems (open and closed systems and control volumes) and its boundaries, properties, state, process, cycle, quasi-static process etc.- required as foundation for development of principles and laws of thermodynamics.
2. Develop intuitive problem solving technique.
3. Develop knowledge of two property rule and hence thermodynamic tables, thermodynamic diagrams and concept of equation of state; also their simple application.
4. Learn and apply heat, work and first law of thermodynamics, Application of energy balance.
5. Relate second law of thermodynamics and its corollaries viz. absolute (thermodynamic) temperature scale, reversibility, entropy, feasibility of a process based on first law and second law, isentropic efficiency of adiabatic machines.
6. Have introductory knowledge of power and refrigeration cycles. Their efficiencies and coefficients of performance.
7. Have introductory ideas of heat transfer in conduction, convection and radiation modes. Application of these concepts to heat transfer in single and combined modes.

**Topics Covered**

**Unit 1** Dimensions and units, system, boundary, types of systems and boundaries, property, cycle, thermodynamic equilibrium and quasi-static process. Pressure and its measurement, zero’th law of thermodynamics, temperature and its measurement, numerical problems.

**Unit 2** Thermodynamic and mechanics’ definition of work, displacement work and its expressions, engine indicator and indicated work, introduction to 2-stroke and 4-stroke engines, heat, work and heat as energy interactions, Joule’s experiment & mechanical equivalent of heat, first law of thermodynamics for cyclic and non cyclic processes, definition of energy as a property, internal energy, enthalpy, specific heats, first law for a control volume, steady flow energy equation (SFEE), and its applications, numerical problems.

**Unit 3** Pure substance, different phases of pure substance, two-property rule, property diagrams, tables and charts, equation of state of an ideal gas, t-τ , t-p, p~v, and p~h diagrams, phase boundaries, S-L-V region, CP and TP, dryness fraction and its measurement using throttling calorimeter, limitation of throttling calorimeter, separating & throttling calorimeter, numerical problems.

**Unit 4** Limitations of first law, heat engine, heat pump, refrigerator, second law of thermodynamics-
Kelvin Planck’s and Clausius statements and their equivalence, efficiency of heat engine and coefficient of performance of heat pump and refrigerator, reversible and irreversible processes, Carnot cycle and its efficiency, corollaries of second law, the thermodynamic temperature scale, inequality of Clausius, entropy, principle of increase of entropy, isentropic process, t~s and h~s diagrams (Mollier chart), second law applications, air standard otto, diesel, dual, simple Brayton and steam power cycles (Rankine cycle), numerical problems.

Unit 5 Modes of heat transfer, Fourier’s law of steady state heat conduction (one dimensional conduction), thermal conductivity and its unit, conduction through slab or plane wall, hollow cylinders and spheres conduction through composite walls and hollow cylinders and spheres with multi-layers, convective heat transfer, Newton’s law of cooling, electrical analogy and overall heat transfer coefficient, combined conductive and convective heat transfer, radiation and radiation properties of surfaces, black body, emissive power, Stefan Boltzmann’s law, emissivity, monochromatic emissive power and monochromatic emissivity, grey body, Kirchhoff’s law, Wien’s displacement law, numerical problems.

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Thermodynamics, An Engineering Approach by Yunus A. Cengel and Michael A Boles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engineering Thermodynamics by R. Joel</td>
</tr>
<tr>
<td>Department</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To give students practice in applying their knowledge of mathematics, science, and engineering and to expand this knowledge into the vast area of Applied Mechanics.
2. To enhance students’ ability to design by requiring the solution of open ended problems.
3. To prepare the students for higher level courses such as courses in Mechanics of Solids, Mechanical Design and Structural Analysis.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Work comfortably with basic engineering mechanics concepts required for analyzing static structures.
2. Identify an appropriate structural system to study a given problem and isolate it from its environment.
3. Model the problem using good free-body diagrams and accurate equilibrium equations.
4. Identify and model various types of loading and support conditions that act on structural systems.
5. Apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem.
6. Communicate the solution to all problems in an organized and coherent manner and elucidate the meaning of the solution in the context of the problem.
7. Develop concepts of rigid body kinematics and dynamics with an emphasis on the modeling, analysis, and simulation of how forces produce motion of rigid body systems.
8. Determine simple dynamic variables and solve simple dynamic problems involving kinematics, energy and momentum.
9. Determine internal actions in statically determinate structures and draw internal action diagrams – Shear Force (SFD) and Bending Moment Diagrams (BMD) for these structures.

**Topics Covered**

Unit 1 Fundamental Concepts and principles of Mechanics. Reduction of a system of forces to a force couple system, Free body diagrams, equilibrium of rigid bodies in 3 dimensions, reactions, loading indeterminacy and solvability. Friction forces and laws of dry friction. Principle and application of virtual work.

Unit 2 Analysis of Multiple particle system: Application of Newton’s laws, linear and angular momentum, kinetic energy and work energy principle, principle of impulse and momentum to a system of particles.

Unit 3 Translation and rotation about a fixed axis, general plane motion, absolute and relative velocity in plane motion, angular momentum of rigid body in plane motion. Problems of motion of rigid bodies and system of rigid bodies, principle of work and energy, conservation of energy for rigid body and a system of rigid bodies.

Unit 4 Analysis of stress and strain: Mechanical properties, analysis of simple state of stress and strains, elastic constants, example of state of tension, compression and shear.

Unit 5 Bending shear and torsion: Concept of bending and shear forces in simple beams, Relationship between load, bending moment and shear force. Bending and shear stresses in simple beams, concepts of torsion in circular shafts.

**Text Books and/or Reference Materials**

**Additional Learning Source**

1. Solid Mechanics by S.M.A. Kazmi
2. NPTEL
3. Web-Learning
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Engineering</td>
<td>ME193</td>
<td>Engineering Graphics Lab</td>
<td>ESA</td>
<td>None</td>
<td>Theory</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Class Work & Home Assignments (60%)
2. End Semester Examination (60%)- 2 Hour

**Course Objective**
1. To understand and appreciate the importance of Engineering Graphics.
2. To understand the basic principles of Technical/Engineering Drawing.
3. To understand the different steps in producing drawings according to BIS.
4. To learn basic engineering drawing formats.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Understand the theory of plane geometric projection and its classifications.
2. Use Plane/diagonal/isometric scales in engineering graphics.
3. Apply various concepts like dimensioning, conventions and standards related to engineering graphics in order to become professionally efficient.
4. Read and interpret drawings of simple machine parts/sectional views in first and third angle of projection systems.
5. Explain the conventions and the methods of orthographic projection and isometric projection.
6. Improve their visualization skills so that they can apply these skills in developing new products.
7. Model simple machine parts in isometric projections.
8. Develop skills to communicate ideas and information through engineering drawing.

**Topics Covered**
Unit 1 Introduction to graphic language, Instruments and their use, Conventional Lines and their uses. Printing of letters and numerals, Methods of dimensioning. Construction and use of scales, Construction of cycloidal curves and involutes.
Unit 2 Necessity for orthographic projections 1st & 3rd angle methods of projection. Projection of points & lines on three coordinate planes, Projections of plane surfaces.
Unit 4 Axonometric Projections. Drawing of isometric projection of simple solids; Development of surfaces of simple solids. Use and methods of drawing.

**Text Books and/or Reference Materials**

**Additional Learning Source**
Web Links :
1. http://nptel.iitm.ac.in/courses.php
2. www.cognifront.com/engdrawing.html
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Engineering</td>
<td>ME194</td>
<td>Manufacturing Process Lab</td>
<td>ESA</td>
<td>None</td>
<td>Theory</td>
<td>2</td>
<td>0 1 2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Reports/Viva-Voce (60%)
2. End Semester Examination (40%) - 2 Hour

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Knowledge and understanding of various types of ferrous and non-ferrous materials used for manufacturing processes.
2. Understanding and selection of processes based upon jobs drawings used for manufacturing.
3. Basic knowledge of hot and cold working processes.
4. Selection and knowledge of various tools applied for cold and hot working processes.
5. Exposure and understanding of machine tools required for manufacturability.
6. Analyze the job manufactured from practical relevance point of view.

**Topics Covered/List of Experiments**

1. To prepare through tennon and mortise joint.
2. To prepare a funnel of GI sheet.
3. To perform filling, drilling and tapping operations.
4. To perform electroplating.
5. Preparation of green sand mould and to perform casting process.
6. To prepare a square headed bolt.
7. To carry out gear cutting by simple indexing.
8. To prepare a single V-butt joint by arc welding and study of gas welding process.
9. To perform facing, simple turning, taper turning, threading and knurling operations on a lathe machine.
10. To perform planing and slot cutting operations on shaper and slotter machines.

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Engineering</td>
<td>CO191</td>
<td>Computer Programming Lab</td>
<td>ESA</td>
<td>None</td>
<td>Theory</td>
<td>2</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

To make students of all branches of B.Tech familiar with the programming concepts and to implement the algorithmic approach of problem solving in C language to gain working knowledge of C programming.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand programming concepts
2. Develop analytical skills for step by step solution for algorithms
3. Solve problems through programming
4. Relate and extend C programming concepts including control statements, strings, functions and programming techniques to solve computational problems.

**Topics Covered**

Introductory discussion of how a computer executes a program. A brief discussion of high level languages, e.g., C, and C++ and low level languages, e.g., assembly language and binary code. An introduction to the translation i.e. compilation process. Experiments to be conducted in the laboratory consist of, but not limited to, the following:

1. Practice of Turbo C as the development environment
2. Simple introductory algorithms and programs for getting input, printing formatted output etc.
3. Programs introducing elementary C concepts, like variable and names
4. Programs using operators
5. Programs using control structures
6. Programs for repetitive tasks and iterations
7. Programs on arrays and strings
8. Programs introducing the use of function calls
9. Programs introducing basic concept of file handling
10. Programs for using basic concepts of storage classes

**Text Books and/or Reference Materials**

2. M. Inamullah and S. M. Zakariya. "CO191 Computer Programming Lab Course Content and Practice Schedule", *Department of Computer Engineering, A.M.U.* (This document can be obtained in PDF format from the instructor).

**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE111</td>
<td>Environmental Studies</td>
<td>ESA</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**

1. To make the students conversant with the basic concept of ecology, environment and chemistry involved.
2. To make the students conversant about the air quality and its standards and how to control air pollution.
3. To make the students gain basic knowledge of Water Quality: Physical, Chemical and Biological parameters.
4. To educationally train the students about the water, wastewater characteristics, purification processes, both natural and advance techniques.
5. To give basic knowledge about importance of the solid waste and its management.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand fundamental physical and biological principles that govern natural processes.
2. Demonstrate an in-depth understanding of the sub disciplines within environmental studies (i.e. Biology, Chemistry, Physics etc).
3. Communicate environmental scientific information to both professional and lay audiences.
4. Demonstrate an understanding of current environmental challenges.
5. Develop a basic fundamental background for the higher environmental engineering courses offered in civil engineering department.

**Topics Covered**


**Unit 2**: Air Quality and Standards, Meteorological phenomena and their influence on Air Quality, Lapse rates, Dispersion of Pollutants. Air Pollution Control: Introduction to Particulate and Gaseous pollutant control.


**Unit 4**: Water purification processes in natural systems: Dissolved Oxygen (DO), Impact of wastewater discharge on streams, Oxygen Sag Curve. Introduction to Water Treatment Technologies: Sedimentation, Coagulation and Flocculation, Hardness Reduction, Filtration and Disinfection.


**Text Books and/or Reference Materials**


### Additional Learning Source

<table>
<thead>
<tr>
<th>Source</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>Course No.</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>CE215</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**
1. To emphasize basic understanding of earth’s exogenous and endogenous environments and forces in context with application in Civil Engineering.
2. To impart the basic knowledge about minerals and rocks-their inherent properties, deformation structures.
3. To know about the spatial distribution of rocks and geotectonic setup to understand the seismic zoning and vulnerability of the regions to various natural hazards.
4. To help the students in comprehending physical and mechanical properties of rocks as construction material and rock mass as founding ground for mega engineering structures such as bridges, tunnels, dams and reservoir apart from geological and geotechnical considerations and investigations.
5. To make students aware of the groundwater system in soil and rocks to highlight the importance of water conservation and sustainability.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Realize the importance of the subject within the framework of fundamental concepts of basic sciences and practical application in civil engineering.
2. Learn about earth processes with which the civil engineers and the structures made by them, come across in the design life of structure and to model their design as per the requirement.
3. Know about different earth materials and their availability for its optimum utilization and need of their conservation, particularly resources like groundwater for sustainable development.
4. Identify physical and mechanical properties of rocks through experimentation and will be able to quantify the properties.
5. Understand the importance of ground investigation for construction projects and predict future behavior of founding ground and accordingly build necessary database and information required for design and construction.
6. Produce technical reports for effective communication amongst stakeholders to comprehend complex problems and accordingly employ state of the art technologies.

**Topics Covered**

**Unit 1** General Geology:
- Introduction to the Earth Sciences.
- Elementary idea about the internal structure of the earth.
- The elementary knowledge of the physical properties of the common rock forming minerals.
- Introduction to the major group of rocks, mode of origin classification and properties.

**Unit 2** Geomorphology and Structural Geology:
- Fundamental concepts of study of landforms.
- Weathering and soil formation.
- Elementary idea of the geological work of glacier, river, sea waves and wind and their engineering significance.
- Deformation of the rocks.
- Dip, strike and structural features including fold, fault, joint and unconformity and their
Unit 3  Stratigraphy and Hydrogeology:
Geological time scale.
Fundamentals of Stratigraphy.
Physiographic and geotectonic divisions of India.
Distribution of rocks of different ages in India.
Concepts of porosity and permeability, water table and types of aquifers.
Occurrence and vertical distribution of water in soil and rocks.

Unit 4  Earthquake, Mass Movements and Site Investigation:
Earthquake, causes, types, intensity and magnitude.
Engineering designs and precautions.
Landslides, stability of hill slopes and road cuttings.
Factors in site selection, alignment and construction of dam, reservoir, bridge and tunnel.

Unit 5  Geotechnical properties of Rocks and Rock Masses:
Rocks as construction material.
Common tests, occurrence and distribution of the building stones, road and rail ballast in India.
Engineering properties and geomechanical classification of rock mass.

Text Books and/or Reference Materials

Additional Learning Source
1. Websites related to Geology and Engineering Geology
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours L</th>
<th>Contact Hours T</th>
<th>Contact Hours P</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE286R</td>
<td>Engineering Geology Camp</td>
<td>ESA</td>
<td>CE 215</td>
<td>Field Camp</td>
<td>1</td>
<td>1 Day Field Trip</td>
<td></td>
<td></td>
<td>1 Day Field Trip</td>
</tr>
</tbody>
</table>

### Course Assessment Method

1. Field Work and Report (60%)
2. Viva-voce (40%)

### Course Objective

1. To supplement theoretical knowledge and to give an idea of practical application gained during the study of theory papers Engineering Geology (CE 215), Geo-Engineering of Rocks and Rock Masses (CE 427) and the Lab course Engineering Geology Lab (CE 293).
2. The field work will help in identifying various rock outcrop patterns and the engineering geology lab has been design to have basics of geological mapping and identification of minerals and rocks.
3. To see and map features in rock mass for rock mass characterization and to develop rock mass models based on engineering properties.
4. To use basic instruments in the field and to generate data base for rock mass characterization.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Learn about the natural ground surface features with emphasis on practical application in civil engineering.
2. Know about different earth materials, their physical properties and their applications seen in natural conditions.
3. Identify field characters of rock mass and shall be able to model rock mass based on engineering specifications.
4. Produce technical reports based on database generated in the field, supplemented by lab tests for effective communication amongst stakeholders and to comprehend problems for specific civil engineering structure, to be erected on rocky ground.

### Topics Covered/List of Experiments

1. Field identification of Rocks, Structures and effect of Weathering.

### Text Books and/or Reference Materials

5. M. Masroor Alam (2013), Fundamental of Engineering Geology and Geoengineering, Axioe books, India

### Additional Learning Source

1. Through On-field Training
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE293R</td>
<td>Engineering Geology Lab</td>
<td>ESA</td>
<td>None</td>
<td>Lab</td>
<td>2</td>
<td>0 1 2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To supplement theoretical knowledge and to give an idea of practical application of the engineering geology lab which has been designed to have basics of geological mapping and identification of minerals and rocks.
2. To understand contour patterns for identifying landforms and topography of an area.
3. To understand and interpret geological maps and to have an idea of rock distribution on ground surface and in subsurface for given topographic profiles and geological sections for different sets of geological maps.
4. To identify common rock forming minerals based on their physical properties.
5. To identify the character of rocks based on texture, structure and composition.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Learn about the ground surface features based on map patterns of contour within the framework of fundamental concepts of basic sciences with emphasis on practical application in civil engineering.
2. Know about different earth materials, their physical properties and their application in day to day use.
3. Identify physical and mechanical properties of rock and its application in civil engineering uses.
4. Produce lab and technical reports for effective communication amongst stakeholders to comprehend complex problems and accordingly employ state of the art technologies.

**Topics Covered/List of Experiments**
1. Topographic and Geological Maps.
2. Geological Sections of Horizontal and Vertical Rocks.
5. Geological Sections of Folded Rocks.
7. Identification of Minerals on the basis physical properties.
8. Identification of Rocks on the basis of physical properties.

**Text Books and/or Reference Materials**
6. M. Masroor Alam (2013), Fundamental of Engineering Geology and Geoengineering, Axioe books, India

**Additional Learning Source**
1. Websites related to Geology and Engineering Geology
## Departmental Core Courses

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE212</td>
<td>Civil Engineering Materials</td>
<td>DC</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

### Course Assessment Method
1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

### Course Objective
1. To introduce students to the science and technology of construction materials.
2. To review important material properties.
3. To teach students how to select appropriate construction materials.
4. To teach technologies of basic construction materials, such as cement, aggregates, concrete, bricks, lime, timber, steel, paints and varnishes, glass, asbestos, bitumen, plastics and composite materials.

### Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Define the fundamental science and engineering principles relevant to civil engineering materials.
2. Outline the characteristics, properties and applications of materials used in construction.
3. Apply the experimental and computational skills for a professional career or post-graduate study in materials.
4. Gain knowledge of the significance of research, the value of continued learning and environmental/social issues concerning civil engineering materials.
5. Communicate effectively, to work in teams and to assume positions as leaders.

### Topics Covered

#### Unit 1

#### Unit 2

#### Unit 3
Bricks: Constituents of Brick earth and their properties, Field tests for soil and manufacture of Bricks, Classification and types of Bricks, Tests for quality control, Properties of masonry units and masonry mortar, Lime: Classification of Lime, Setting of Lime, Specifications.

#### Unit 4

#### Unit 5
Properties and uses of Glass, Asbestos, Bitumen, Plastics etc., Industry and environment – Use of waste, alternate and non standard construction materials.

### Text Books and/or Reference Materials
1. Building Construction and Materials by Gurcharan Singh  
2. Building Construction by Arora and Bindra  
3. Engineering Materials by Surender Singh  

**Additional Learning Source**  
1. Building Materials by S. K. Duggal
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE213</td>
<td>Fluid Mechanics</td>
<td>DC</td>
<td>ME111</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The main objective of this course is to understand the basics of the fluid mechanics such as fluid and flow properties, fluid behaviour at rest and in motion and fundamental equations like mass, energy and momentum conservation of the fluid flow.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the basic properties of fluids, mechanics involved in fluid flow and to designate the types of flow based on dominant fluid property and space and time.
2. Understand the significance of basic principles of floatation and stability of floating bodies like boats, ships, naval vessels etc.
3. Apply fundamental concepts of fluid statics in analysing the forces on hydraulic structures such as water tanks, retaining walls, lock gates, sluice gates, dams etc and also check their stability.
4. Apply fundamental concepts of fluid dynamics in solving problems like computation of force exerted by water jet on various types of vanes used in pelton wheel turbines.
5. Apply fundamental concepts of fluid mechanics in solving fluid flow problems like computation of discharge through pipes using orifice meter, venturimeter, and bend meter and through canals using weirs, sluice gates etc.

**Topics Covered**

- **Unit 1** Kinematics of fluid flow: Introduction, Fluids Properties and classification; Concept of viscosity, Compressibility and Elasticity, Surface tension and capillarity. Flow Classification, Stream lines, Streak lines, Continuity equation, Velocity, Tangential, Normal, Local and Convective Accelerations, Types of fluid motions, rotation, Circulation, Velocity potential, Stream function, Flownet.
- **Unit 2** Hydrostatics: Pascal law, Hydrostatic law, Relative equilibrium, Pressure measurements, Manometers, Forces on immersed plane and curved surfaces, Buoyancy, Stability of floating and submerged bodies.
- **Unit 3** Equation of Motion: Bernoulli’s equation, Energy correction factor, Coefficients of contraction, velocity and discharge, Differential head meters, Free vortex motion, Analysis of free liquid Jet, Cavitation. Linear momentum equation, Force on pipe junctions and bends, Forces on moving plates and vanes due to fluid flow, Angular momentum, and Forced vortex.
- **Unit 4** Flow Measurement: Orifices, Mouth pieces, Weirs, Flow under sluice gates. Time of emptying tanks with or without inflow, Flow of liquid from one vessel to another.

**Text Books and/or Reference Materials**

5. R.J. Garde, “Fluid Mechanics” RPH, Roorkee, India.

**Additional Learning Source**
1. Web links to open courseware materials by Henderson, “Open channel flow”
2. Web links to e-learning: *nptel*
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE216</td>
<td>Structural Mechanics</td>
<td>DC</td>
<td>ME111</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop an appreciation of forces in simple determinate structures like dams, retaining wall and chimneys etc.
2. To develop basic understanding of three dimensional state of stress in materials and structures.
3. To examine stability of simple structural elements such as dam, retaining wall, chimney and columns under given support and load conditions.
4. To analyze simple structural elements such as dam, retaining wall, chimney and columns for given forces.
5. To develop understanding of basic principles and methods of analysis: (a) General Energy theorems i.e. (a) Castigliano’s theorem, Maxwell Betti’s theorem and Virtual work theorem and (b) Euler’s Formula, Rankines’s law and Perry’s formula for columns.
6. To apply energy methods for analyzing simple beams and frames for given load and support condition.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Develop basic concepts of forces acting on simple structural elements and also the concept of combined stresses (3D stress state) in materials used in Civil Engineering.
2. Understand the behavior of simple (selected) structural elements under applied forces.
3. Understand the basic principles used in the analysis of structural members.
4. Recognize and be able to apply fundamental principles to check the stability of structural elements.
5. Generate an ability to apply the knowledge of stress state in the design of structural elements.
6. Apply the basic principles of structural mechanics in analysis of simple structural members.

**Topics Covered**

Unit 1 Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder

Unit 2 Generalized state of stress and strain: Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-westerguard’s stress space.

Unit 3 Deflection of beams; Load deflection relationship of beam, Deflection calculation by double integration, moment area and conjugate beam methods.

Unit 4 Energy methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano’s theorem, Maxwell Betti’s reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

Unit 5 Structural stability; Stability of columns, Euler’s formula, end conditions and effective length factor, Columns with eccentric and lateral load.

**Text Books and/or Reference Materials**


**Additional Learning Source**
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE217</td>
<td>Construction Practice</td>
<td>DC</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1 0</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**

The objective of this course is to impart the state of art construction practices of buildings and other structures including site preparation, foundation systems, superstructures, enclosures, utilities, finishing, methods and materials. The crack repair techniques for buildings and its elements will also be discussed. The prevalent techniques for damp proofing, termite proofing and fire resistance will also be explained.

**Course Outcomes**

Upon successful completion of this course, the student will be able to:

1. Understand the codal requirements for building construction purposes.
2. Identify the site requirements on which to build large and small buildings, bridges and other structures.
3. Select an appropriate footing/foundation system for different soil and site conditions.
4. Describe several different superstructure systems used for residential/ commercial/ industrial buildings, bridges and other structures.
5. Select appropriate acoustical and thermal insulation systems for specific situations.
6. Identify various finishing systems and materials used for completing construction projects.
7. Devise ways and means to overcome the problems of dampness, termite proofing and thermal resistance.
8. Identify and describe fire safety issues relating to the construction industry.

**Topics Covered**

**Unit 1**
Building planning, site selection, orientation, principles of planning the building, open air space, requirement of parts of buildings, lighting and ventilation, requirements of various rooms, Building bye laws.

**Unit 2**
Components of building and their purpose and types; foundations, walls, columns, roofs, doors, windows; Bands and openings in the buildings - seismic requirements; Vertical transport in structures; Building finishes; Basic design of foundation of buildings, Terms used in brick masonry, Bond and types of mortars.

**Unit 3**
Excavation, dewatering, shoring, underpinning and scaffolding, drilling, blasting, well sinking and pile driving, cofferdams, form work-fabrication and use. Construction techniques for special structures such as high-rise buildings, road construction, dams, bridges, offshore platforms.

**Unit 4**
Damp proofing; causes and effect of dampness, material and method of damp proofing; Termite proofing, pre and post construction treatment; Thermal insulation, methods of thermal insulation, thermal insulation of roofs, exposed walls; Doors and windows, Stair case; parts and type of stairs, dimensioning of stair case.

**Unit 5**
Fire protection- fire hazards, characteristics of fire-resisting materials and common building materials; Cracks in walls, floors and ceilings-causes and repairs techniques; Routine maintenance of building and structures.

**Text Books and/or Reference Materials**


**Additional Learning Source**

Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CE218R | Surveying | DC | None | Theory | 4 | 3 | 1 | 0 | 4

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To learn the different techniques of measurements of distances, directions and elevations.
2. To learn about the procedures of preparations of topographical maps of the areas.
3. To learn about the process of establishment of horizontal control points necessary for carrying out survey of the area.
4. To learn about the principles involved in the advanced surveying instruments.
5. To learn about the techniques of layout of curves in transportation engineering.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Calculate capacity of earthwork required for the construction of different engineering projects.
2. Plan different engineering projects of importance.
3. Apply the knowledge gained in execution of different engineering projects like laying of sewers, construction of canals, roads and railways.
4. Gain knowledge in decision making in the proposals of construction of roads, railways, sewers etc.
5. Gain knowledge in the establishment of mean sea level, construction and maintenance of port facilities, reduction of levels including establishment of bench marks, layout of various engineering projects.

**Topics Covered**

Unit 1 Introduction to conventional surveying methods like chain surveying, compass survey and Plane Table Survey.

Unit 2 Levelling; definition, instruments, methods of levelling, theory of direct levelling, spirit levelling, differential levelling, curvature and refraction, reciprocal levelling, profile levelling, cross-sectioning, Barometric levelling; Sensitiveness of bubble tube, permanent adjustment of level.

Unit 3 Triangulation, classification of triangulation system, triangulation figures, signals and towers, phase of signal inter visibility and height of stations, base line measurement, use of EDM instruments, corrections to measured length; Measurement of horizontal angles; satellite stations, reduction to centre.

Unit 4 Curves, simple, compound, reverse, transition and vertical curves.

Unit 5 Theodolite and traverse surveying; essential parts of transit theodolite, temporary and permanent adjustment of transit theodolite; Measurement of horizontal and vertical angles; Methods of traversing, closing error, balancing of traverse, traverse table, omitted measurements. Tachometry, stadia system, influence of staff tilt, anallactic lens, tangential and subtense systems.

**Text Books and/or Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: nptel
### Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

### Course Objective

1. To develop an appreciation of need, importance and scope of hydrology in Indian perspective.
2. To develop an understanding of various components of hydrological cycle, their behaviour and factors affecting.
3. To discuss the importance of estimation of runoff, analysis of rainfall data and various hydrographs such as unit hydrograph, flood hydrograph and synthetic unit hydrograph.
4. To develop technical skills for preparation of water resources project documents by knowing the design parameters based on the knowledge of various types of hydrological parameters.
5. To build the necessary theoretical background of ground water hydrology, types of aquifers and their yields.
6. To solve simple problems on water-budget, infiltration, measurement of average rainfall, evaporation, potential evapotranspiration and flood hydrographs.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the fundamental concepts of hydrological cycle, occurrence and distribution of surface, sub-surface and deep ground water.
2. Understand the significance of various hydrological parameters, types and forms of precipitations.
3. Apply the knowledge in watershed management and reservoir yields.
4. Estimate the efficacy of raingauge network, runoff from a catchment and ground water recharge.
5. Apply S-curve method for changing the duration of a given unit hydrograph and estimation of peak flood for un-gauged catchments.
6. Create the necessary theoretical background for computing the peak flood for a water resources project based on the unit hydrograph approach.

### Topics Covered

**Unit 1**
Scope and applications of hydrological cycle, Hydrology applied in Engineering, Precipitations types and measurement, Rain gauge, Network analysis of rainfall data.

**Unit 2**
Evaporation, Evapotranspiration, Consumptive use, infiltration and percolation, methods of determination of infiltration, factors affecting infiltration.

**Unit 3**
Surface runoff, factors affecting runoff, measurement of runoff, Analysis of runoff data. Hydrographs, Flow Mass curve and Flow duration curve, Concept of Unit Hydrograph, Methods of Estimation of Unit Hydrograph, Derivation and application.

**Unit 4**
Ground Water Hydrology, Definitions, Types of Aquifers and Wells, Occurrences, Distribution, Darcy’s law and its limitations, Well hydraulics.

### Text Books and/or Reference Materials

<table>
<thead>
<tr>
<th><strong>Additional Learning Source</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Web links to e-learning: <a href="http://nptel.ac.in">nptel</a></td>
</tr>
<tr>
<td>Department</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The main objective of the course is to develop basic understanding of civil engineering construction drawings, so that the students get a better insight into the subject, which can subsequently be used in the professional practice.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Understand and interpret civil engineering construction drawings.
2. Prepare Bill of Quantities (BOS), Bill of Materials (BOM) and Labour statements strictly adhering to the specifications and the construction drawing.
3. Develop insight in tendering of new projects and related contract documents.

**Topics Covered**

Unit 1 Plan, elevation and sectional elevation of building drawing, Key or Index Plan, Parts and types of stair cases, Exposure to AutoCAD. Quantity Survey and its requirements, types of estimates, methods of estimates, Principle and units of measurements, rules of measurements.

Unit 2 Analysis of rates, Purpose and requirements of rate analysis, Factors affecting rate analysis, Analysis of rates for main items. Abstract of Cost.

Unit 3 Specifications – Definition and Types of specifications, Specifications of main items, Different areas in a building. Capital cost of a project, Material Statement, Area requirements for different functions, building by-laws.


**Text Books and/or Reference Materials**

1. Civil Engineering Contracts and Estimates by B.S Patil, Orient Longman
2. Estimating and Costing by B.N Dutta
3. Text and documents published by various professional bodies & CED like CPWD

**Additional Learning Source**

2. Web links to e-learning: nptel
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE311</td>
<td>Design of Concrete Structures-I</td>
<td>DC</td>
<td>ME 111</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The objective of CE-311 is to introduce the theory and application of analysis and design of reinforced concrete elements. The course focuses on the understanding the behaviour of reinforced concrete components and systems subjected to gravity loads.

After taking this course the students will be able to classify and identify structures based on their behaviour and further analyse, design and detail the various components of structure subjected to gravity loads. They will also be able to interpret and understand the relevant BIS codes and Special publications of BIS.

1. Review of limit state method of design concepts and applications.
2. Design of reinforced concrete beams and one-way slabs in flexure.
3. Design of reinforced concrete beams and one-way slabs in shear.
4. Design of reinforced concrete beams and one-way slabs for bond and anchorage, location of bar cut-off points.
5. Design of beams for torsion.
6. Design of members subjected to axial load and bending, Methods to account for slenderness effects.
7. Design of column supported and wall supported slabs.
8. Analysis and design of circular slabs.
10. Serviceability considerations for beams and one-way slabs, cracking and deflections.
11. Course work includes submission of design sheets.
12. Conducting experiments on pre-designed reinforced concrete beams highlighting flexural and shear failure.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Recognize the design philosophy of the reinforced concrete structures.
2. Understand the difference between the structural behaviour of different reinforced concrete structural elements through demonstration experiments and analysis.
3. Analyze and design different elements of reinforced concrete structural elements under gravity loads and submit the designs in complete and concise manner.
4. Use the techniques, skills, and modern engineering tools necessary for design and detailing.
5. Analyze and interpret the results using analytical tools and further plan, design and detail different civil engineering structures.
6. Design a structure/component, to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability as per the codal provisions.
7. Follow relevant and upcoming BIS standards and design philosophies prevalent in the world.
8. Interact and manage work with professionals of diverse background and talent.

**Topics Covered**

Unit 1 Limit state method of design- concepts. Loads and stresses, load combinations. Analysis and design of sections in bending, rectangular and T-section beams with reinforcement in compression. One way slabs.
## Text Books and/or Reference Materials

4. Verghese, P.C. “Advance Reinforced Concrete Design” Prentice-Hall of India, New Delhi, India.
5. I.S: 456-2000- Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi, India.
10. S.P:34- Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi, India.

## Additional Learning Source

1. George Winter “Design of Concrete Structures”, McGraw-Hill, USA
3. Web links to e-learning: nptel
4. Study through Journal Papers Indian Concrete Journal India
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE312</td>
<td>Soil Mechanics</td>
<td>DC</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**

1. To develop an appreciation of soil as a vital construction material, so that it may subsequently be used in the design and construction of foundation for civil engineering structures.
2. To develop an understanding of the relationships between physical characteristics and mechanical properties of soils.
3. To inculcate the basic knowledge of soil such as its identification and classification, determination of various engineering properties and its suitability as a foundation/subgrade material.
4. To understand and experience experimental measurement of the physical and mechanical soil properties commonly used in engineering practice.
5. To develop good technical reporting and data presentation skills.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

2. Understand the significance of the properties of soils, and also the experimental methods used to measure them.
3. Recognize and be able to apply fundamental soil mechanics principles underlying common Civil Engineering applications.
4. Understand both the applications and limits of engineering methods commonly used to solve soil mechanics problems in Civil Engineering.
5. Aware of more advanced techniques those are available for common and difficult problems.
6. Recognize the importance of good written communication skills, and know how to write professional, clear, concise technical reports and letters to clients and colleagues.
7. Build the necessary theoretical background for design and construction of foundation systems, with utmost safety and economy.
8. Develop the understanding of various BIS and ISO standards and to design the foundations of structures in conformity with these codes.

**Topics Covered**


Unit 2  Soil water, Permeability: Soil water, effective and neutral pressures. Darcy’s law, factors affecting permeability. Laboratory determination of permeability. Permeability of stratified soils. Quick sand conditions and liquefaction of soil.

Unit 3  Soil stresses: Stresses in soil mass due to surface loading. Boussinesq and Westergaard’s formulae for point load. Pressure bulb. Vertical pressure under various uniformly loaded area. Newmark’s influence chart. Approximate methods.

Unit 4  Compressibility and Consolidation: Virgin compression curve and definition of the terms. Terzaghi’s one dimensional consolidation theory. Laboratory consolidation test, height of solids and change in voids ratio.

**Unit 5  Shear Strength of Soil:** State of stress at a point, Mohr’s stress circle. Shear strength of soil. Mohr and Mohr-Coulomb failure envelop. Direct, Triaxial, Unconfined and Vane shear tests, principles of drained and undrained tests, stress path.

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Som and Das, “Theory and Practice of Foundation Design”, PHI, Delhi, India.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. M.J.Tomlinson, “Foundation design and construction”</td>
</tr>
<tr>
<td>3. Web links to e-learning: <a href="https://nptel.ac.in">nptel</a></td>
</tr>
<tr>
<td>Department</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To make the students conversant about the environmental pollution problems related to land, air and water.
2. To make the students conversant about the principles of water treatment processes including the problems involved in handling the different sources of water supply.
3. To impart basic knowhow of the process of collection and distribution of domestic wastewater and to make them learn about the different techniques of onsite treatment of sewage.
4. To impart a comprehensive knowledge of the different wastewater treatment processes including the latest state of the art technologies.
5. To get a brief idea of solid waste collection, its sources and characteristics and the different methods of disposal of solid waste.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Serve the community by making people aware with the different pollution related problems.
2. Gain knowledge of the different processes of water treatment and would be able to assist in the design of the water treatment plants.
3. Design a sewerage system for the town and would assist in the design of wastewater treatment plants.
4. Recognise the importance of management of solid waste and thus would assist in maintaining proper hygienic conditions.
5. Help in the prevention of water borne disease thus improving the health conditions of the people.

**Topics Covered**


Unit 2 Water treatment flow sheets, screenings, coagulation, flocculation, filtration, disinfection, hardness reduction, removal of iron and manganese.

Unit 3 Wastewater Characteristics, Wastewater treatment flow sheets, screens, grit removal, sedimentation, activated sludge process, trickling filter, anaerobic digestion.

Unit 4 Low cost treatment systems, Stabilization ponds, lagoons, wetlands Septic tank, Sludge Treatment.

Unit 5 Water supply connections for buildings, Sanitation systems, Design of sewers, Building drainage systems.

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE315</td>
<td>Structural Analysis-I</td>
<td>DC</td>
<td>CE216</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop an understanding of various types of structures and their built to facilitate the performance of various activities connected with residence, transportation, storage, healthcare etc. in the field of civil engineering.
2. To develop an understanding of the behavior of structure under serviceability load.
3. To understand the mechanics of the material behavior of different types of structures.
4. To make student aware of various procedure of analysis like Mohr’s theorem, method of consistent deformation, reciprocal theorem, Betti’s theorem, energy theorem etc. for statically indeterminate structures.
5. To develop good technical reporting and data presentation skills.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concepts of mathematics, statics, mechanics of deformable bodies, and principle of dynamics to the solution of fundamental civil engineering structural analysis problems.
2. Apply structural codes and standards such as IS 1875 (part-2&3) and IS: 1893 (Part-I) to model dead, live, snow, wind, and earthquake loads on structures.
3. Understand the significance of the basic mechanical properties of structural materials.
4. Understand how to represent real structures by idealized structural systems.
5. Understand the deformations of structures under loading and be able to apply various methods to determine the deformations.
6. Develop the ability to analyze cable and arch structures.
7. Solve statically indeterminate structures using classical methods.
8. Familiarise with professional and ethical issues and the importance of lifelong learning in structural engineering.

**Topics Covered**

**Unit 1 Statically Indeterminate Structures:**

*Statically indeterminate Beams:*

Introduction, Types of Supports: Reaction Components, External redundancy, Degree of redundancy of articulated structures, Degree of redundancy of rigidly jointed frames, Degree of kinematic indeterminacy, Method of Analysis.

*Fixed beam:*

Bending moment diagrams for a fixed beam-free bending moment diagram- Fixed bending moment diagram, Fixed beam subjected to various types of loading, Fixed beam with ends at different levels (effect of sinking of supports), Fixed beam subjected to couples, Degree of fixity at supports, Advantages and disadvantages of indeterminate beams.

*Continuous Beams:*

Claypeyron’s theorem of three moments, Propped cantilever, Continuous beams with sinking of supports, Continuous beam with overhang, Continuous beams with different sections for different spans.
**Consistent Deformation Method:**
Introduction, Maxwell’s law of reciprocal deflection, Generalized Maxwell’s Theorem: Betti’s Reciprocal Theorem.

**Unit 2 Displacement Methods:**
- **Slope deflection method:**
  Basic Concepts, Sign Conventions, Fundamental Equations, Continuous Beams and Frames without joint translations, Portal Frames with side sway.
- **Moment Distribution Method:**
  Introduction, Basic propositions, Stiffness of a member, The distribution theorem, The carry-over theorem, Relative stiffness- distribution factors, Continuous beams on elastic props, Portal frames, Non-sway and sway frames, Portal Frames with inclined members

**Unit 3 Indeterminate Pin jointed perfect frames and redundant frames:**
- **Perfect Frames:**
  Deflection of perfect frame, General, The unit load method, Deflection by Castigliano’s First theorem Maxwell’s reciprocal theorem applied to frames, Graphical Method
- **Redundant Frames:**
  Degree of redundancy, Application of Castigliano’s theorem of minimum strain energy, Maxwell’s method, Stresses due to error in length.

**Unit 4 Arches:**
- **Introduction,** Geometric properties, Basic Mechanics, Arch action.
  - **Three hinged arch:**
    Beam moment and H- moment, Horizontal thrust, Circular arches, Parabolic arches, Arches with supports at different levels
  - **Two hinged arches:**
    Parabolic arch, Circular arch, Two hinged arch with laterally yielding supports, Inter-connected arches, Temperature effect on two hinged arches, Tied arch, Fixed arch, Moving loads and influence lines.

**Unit 5 Cables and suspension bridges:**
- **Cables:**
  Equation of the cable, Horizontal tension in the cable, Tension in cable supported at different levels, Length of the cable, Effect on cable due to change of temperature, Cables on pulley and saddle.
- **Stiffening girders:**
  Cables with three hinged stiffening girder, Influence lines for shear force and bending moment at a given section of the stiffening girder, Cables with two hinged stiffening girder, Influence line diagrams, Temperature stresses in two hinged girders

**Text Books and/or Reference Materials**
2. Structural Analysis by Negi and Jangid (TMH Publications).
3. Fundamental of Structural Analysis by Sujit Kumar Roy and Subrata Chakrabarty (S.Chand Publishers)

**Additional Learning Source**
2. Elements of Structural Analysis by N C Sinha (New Central Book Agency).
3. Web links to e-learning: nptel
Civil Engineering  

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE316</td>
<td>Engineering Hydraulics-I</td>
<td>DC</td>
<td>CE213</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop the fundamental concept for methods of dimensional analysis and models studies.
2. To develop an understanding of the viscous flow and its governing equations.
3. To understand the basic concepts of boundary layer and theory of boundary layer flow.
4. To develop an understanding of the turbulent flow and its governing equations.
5. To apply the theories of laminar and turbulent flow to solution of some typical pipe flow problems in the field and boundary layer theory to estimate the drag and lift for various shapes of the objects.
6. To understand the design philosophy of turbines and pumps.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Carry out model studies of various hydraulic structures such as weir, barrages, dams, bridge piers, spillways, energy dissipaters, flood embankments.
2. Solve various viscous flow problems such as flow through porous media, blood circulation in human body, design of settling tank, dusting in atmosphere, leakage through cracks in water tank.
3. Apply the theory of boundary layer flow to estimate the lift and drag on various shapes of the objects.
4. Solve the turbulent flow problems relating pipe flow and open channels.
5. Apply the theories of laminar and turbulent flow to solution of pipe flow problems in the field.
6. Design various types of turbines and pumps.

**Topics Covered**

Unit 1 Laminar flow, Navier’s-Stokes equation of motion for laminar Flow; Laminar flow between two parallel plates, laminar flow through pipes, Dimensional Analysis & Modal Studies. Velocity distribution in turbulent flow; shear stress due to turbulence, turbulent flow in circular pipes, resistance of smooth and artificially roughened pipes, General resistance diagram.

Unit 2 Boundary Layer Theory: Introduction, Development of boundary layer over a flat plate, boundary layer thickness, displacement, momentum and energy thicknesses, Application of momentum equation to boundary layer flow, local and mean drag coefficients, Hydro-dynamically rough and smooth surfaces, boundary layer separation and its control, Forces on Immersed bodies: Drag and lift, drag on flat plate, sphere, cylinder and disc, development of lift, Magnus effect and circulation, theoretical lift on rotating cylinder.

Unit 3 Pipe Flow Problems: Losses in pipe flow, pipes in series, pipes in parallel, branching pipes, siphons, multi-reservoir problems, pipe net works, unsteady flow in pipes, water hammer analysis.

Unit 4 Hydraulic Machines: Turbines: classification of tribunes, Impulse and Reaction turbines, characteristic curves, draft tubes, Pumps: classification of pumps, centrifugal pump, efficiency and power, Output of centrifugal pumps, characteristics curves.

**Text Books and/or Reference Materials**


**Additional Learning Source**
2. Web links to e-learning: nptel
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE317</td>
<td>Transportation Engineering</td>
<td>DC</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To give an overview of the transportation engineering.
2. To describe the basic characteristics of transportation planning and of the models used by transportation planners.
3. To describe highway design objectives, constraints and controlling factors.
4. To describe the criteria, standards and engineering procedures used to design principal elements of the highway alignment, and highway cross sections.
5. To understand the process of collecting information necessary for successful design of flexible and rigid pavements, including traffic data, material properties and other environmental factors.
6. To give an insight about the basics of Railway and Airport Engineering.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the basic concepts of geometric design of highways by applying fundamental concepts of Mathematics and Laws of Mechanics.
2. Propose a feasible solution to fundamental highway engineering analysis/design problems.
3. Apply condition monitoring and maintenance of road pavements.
4. Conduct experiments on materials for Highway Engineering.
5. Develop technical skills for operations and design of road junction.
6. Develop technical skills for road pavement construction.
7. Design both flexible and rigid pavements.
8. Recognize the importance of good written communication skills, and know how to write professional, clear, concise technical reports and letters to clients and colleagues.
9. Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes.

**Topics Covered**

- **Unit 1** *Highway Planning and Geometric Design:* Highway development and planning in India, Pavement Characteristics, Sight distances, Design of horizontal and vertical alignment.
- **Unit 2** *Highway Material and Construction:* Properties of sub-grade and pavement component material, tests on stone aggregate and bituminous materials. Highway construction – WBM, bituminous and cement concrete pavement.
- **Unit 3** *Pavement Design:* Design factors for flexible and rigid pavements. Group Index and CBR methods for flexible pavement design. Analysis of wheel load stresses in rigid pavement. Westergaard’s method for design of rigid pavement.
- **Unit 4** *Railway Engineering:* Gauges, creep and wear of rails. Sleepers, station and yards, points and crossing. Tractive resistance.
- **Unit 5** *Airport Engineering:* Airport planning and Airport layout- runway orientation, Wind Rose diagram, basic runway length, corrections for runway length. Airport classification, geometric design. Airport capacity, Aircraft parking systems.

**Text Books and/or Reference Materials**


<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Web links to e-learning: nptel</td>
</tr>
<tr>
<td>Department</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The objective of CE-318 is to introduce the theory and application of analysis and design of steel structures. The course focuses on understanding the behaviour of steel structural components subjected to gravity loads.

1. Review of design concepts and applications
2. Design of tension members subjected to axial tension
3. Design of tension members subjected to axial tension and bending
4. Design of axially loaded compression members and built up members
5. Design of lacings and battens
6. Design of spliced tension and compression members
7. Design of column bases and grillage foundations
8. Design of flexural members, plate girder and its components
9. Design of roof trusses and its components
10. Plastic analysis and design of simple beams and frames
11. Course work includes submission of tutorial sheets and design sheets. Use of AUTOCAD for drawings.

After taking this course the students will be able to classify and identify structures based on their behaviour and further analyse, design and detail the various components of structure subjected to gravity loads. They will also be able to design roof truss components when subjected to wind loads. They will also be able to interpret and understand the relevant BIS codes and Special publications of BIS.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Recognize the design philosophy of the steel structures
2. Understand the structural behaviour of different steel structural elements and their analysis
3. Analyze and design different elements of steel structural elements under gravity loads and submit the designs in complete and concise manner.
4. Use the techniques, skills, and modern engineering tools necessary for design and detailing.
5. Analyze and interpret the results using analytical tools and further plan design and detail different civil engineering structures.
6. Design a structure/component, to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability as per the codal provisions
7. Follow relevant and upcoming BIS standards and design philosophies prevalent in the world.
8. Interact and manage work with professionals of diverse background and talent.

**Topics Covered**

**Unit 1** Properties of material and connections:
- Mechanical properties of steel, Loads and stresses, load combinations, Design of semi-rigid, rigid and moment resisting welded, riveted and bolted connections.

**Unit 2** Tension and compression members:
- Design of members subjected to axial tension, Design of members subjected to axial tension and bending, Design of compression members, Design of built up columns, Design of splicing, Design of built up column and their bases, Design of grillage foundations, Design of beam-column connection.
Unit 3  Flexural members and plate girder:
Design of beams, Lateral stability of beams, Design of laterally supported and unsupported beams,
Built-up beams, Encased beams, Design of Plate girder and its components.

Unit 4  Design of industrial building:
Structural framing and elements of an industrial building, Loads on a industrial building, Design of truss, Design of components of truss and bracing, Design of gantry girders.

Unit 5  Plastic analysis and design:
Introduction to plastic analysis, Theorem and methods of plastic analysis, Simple cases of beams and frames.

Text Books and/or Reference Materials
3. K.S. Sairam “Design of Steel Structures”, Pearson, Delhi, India
5. Kazmi, S.M.A and Jindal R.S “Design of Steel Structures” PHI, New Delhi, India
6. Arya and Ajmani “Design of Steel Structures”, NCB, Roorkee, India
7. Ram Chandra “Design of Steel Structures”, Vol. I & II, Standard Book house Delhi, India
8. I.S: 800-2007- Code of Practice for General Construction in Steel, BIS, New Delhi, India
9. I.S: 808-1989- Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections, BIS, New Delhi, India

Additional Learning Source
1. Web links to e-learning: nptel and insdag
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Prerequisits</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE411</td>
<td>Design of Concrete Structures-II</td>
<td>DC</td>
<td>CE 311</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

**Course Objective**

1. To make students conversant with the design of structures like Continuous beam, Tanks, Prestress Concrete Structures, Bridges, Staircases and Retaining walls.
2. To enable the students execute the drawing with adherence to specification mentioned.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Remember the values of minimum and maximum cement consumption in section of the beams and columns and tank walls ordinarily used in every day structure.
2. Identify the various types of deformations in different structures e.g. compression tension hoop occurring at a particular structure atleast qualitatively.
3. Develop the wisdom of structural engineering i.e. the application of the knowledge in that area which was not taught specifically in the course.
4. Explain the deformation/structural action of any constructed, field, monumental structure
5. Diagnose the damaging cause/ lapses happened leading the structure unfit for the use.
6. Comment on the overall performance of the structure and can predict useful life of the structure.
7. Prepare models for engineering solution of any problem qualitatively and this knowledge acquired by the student can be used directly and indirectly developing/ repairing of any household product.

**Topics Covered**

Unit 1 Design of continuous beam and building frame, Moment redistribution, Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, Detailing of earthquake resistant construction –ductility criterion.

Unit 2 Introduction to Water tank design, Design criterion, Design of rectangular and circular water tanks, Design of Intze tank and overhead tank staging.

Unit 3 Introduction to bridge engineering, Investigation for bridges, IRC loading, Design of slab culvert.

Unit 4 Introduction to prestressed concrete, prestressing systems, losses in prestress, Design of short span girders, design of end blocks.

Unit 5 Design of staircases, Design of cantilever and counterfort type retaining wall and frames.

**Text Books and/or Reference Materials**

1. Jain, A.K “Reinforced Concrete-Limit State Design” NCB, Roorkee, India
2. Raju, N. K “Prestressed Concrete, TMH, Delhi, India
3. Karve and Shah “Limit State Theory and Design of Reinforced Concrete” VGP, Pune, India

**Additional Learning Source**

1. Pillai and Menon “Reinforced Concrete Design” TMH, New Delhi, India
2. Verghese P.C “Advanced Reinforced Concrete Design” PHI, Delhi, India
3. Web links to e-learning: nptel
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE413</td>
<td>Foundation Engineering</td>
<td>DC</td>
<td>CE 312</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The objectives of the course is to introduce the theory and application of analysis and design of earth retaining structures, slope stability analysis, shallow and deep foundations and machine foundations. The course focuses on the understanding the behavior and design of rigid, flexible walls and pile foundations of the structures subjected to static and dynamic loads. The main objectives of the course are:

1. To develop an understanding to perform site investigations and to determine the soil parameters needed to carry out foundation design.
2. To learn the subsurface exploration techniques and apply them to design the foundations and retaining walls.
3. To understand and be able to apply the modelling and analysis techniques used in design of foundation: (a) Coulomb’s and Rankine’s theory for earth retaining structure; (b) Terzaghi’s and Skempton’s analysis for bearing capacity; (c) Engineering News and Hiley’s formula for load carrying capacity of pile.
4. To apply the principles of soil mechanics to design of shallow and deep foundations including bearing capacity, stability analysis of slopes and settlement calculations.
5. To compute the lateral earth pressure, select size of retaining walls and ensure safety against external forces and moments.
6. To enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concept of mathematics, statics and mechanics to understand the essentials of the method of bearing capacity and stability analysis.
2. Analyse and design a variety of geotechnical engineering structures including foundations, piles, retaining walls, slopes and interpret data.
3. Recognize behavior of soils in slopes, behind retaining structures and phenomena affecting foundation capacity and settlement.
4. Determine allowable bearing pressures and load carrying capabilities of different foundation systems.
5. Evaluate appropriate bearing capacity correction factors and apply related equations in design.
7. Identify the appropriate deep foundation type for different soil profiles.
8. Specify pile material types for various applications and calculate side/tip capacity of driven piles in clay and sand.

**Topics Covered**

Unit 1 Earth Pressures and Retaining Structures: Active, Passive and Pressure at rest, Rankine’s and Coulomb’s theories; Influence of surcharge, layered soil and water table. Rebhann’s and Culmann’s graphical constructions of active pressure for cohesionless soil, Simplified procedure for design of sheet pile walls and anchored bulk heads.

Unit 3 Shallow Foundations: Definitions, Bearing capacity of footings, Terzaghi’s, Meyerhof’s and Skempton’s analysis, Effect of rising and lowering of water table on bearing capacity, Permissible, Total and Differential settlements as per IS Code, Plate load test, Standard and Cone penetration tests for determining allowable bearing pressure.

Unit 4 Deep Foundation and Site Investigation: Introduction to pile foundation. Load carrying capacity of piles by Engineering News and Hilley’s formulae, Bearing and friction piles, Bearing Capacity of single pile and pile groups, Boring and sampling techniques, Disturbed and undisturbed soil samples, Area ratio, External and internal clearance.

Unit 5 Design Criteria, Free and Forced vibrations for single degree of freedom system, Undamped and damped case, Vibration analysis of machine foundation, Determination of mass, spring stiffness, damping constant, Barkan’s method for natural frequency, Transmissibility and amplitude.

Text Books and/or Reference Materials

Additional Learning Source
4. www.ce.washington.edu/~geotech/courses/cee523/manuals/
7. www.dfi.org/
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Designation</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE414</td>
<td>Engineering Hydraulics-II</td>
<td>DC</td>
<td>CE 316</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To describe the various types open channel flows based on space, time, Reynolds Law and Froude Law.
2. To apply the concept of specific energy in evaluating change in elevation or bed width for obtaining critical flow and design of transitions.
3. To understand physical, geometrical properties of open channel and to quantize most efficient channel.
4. To understand how water surface profile changes upstream and downstream of a control structure and how these structures are used as flow meters.
5. To understand and apply the modelling and analysis techniques used in open channel flows: Froude Law, Manning's Law for Hydraulic structures and rivers.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concepts of Mathematics, Fluid Mechanics and Specific energy to the solution of critical flow and transition problems.
2. Understand the significance of critical flow and uniform flow and apply these concepts in gradually varied flow problems.
3. Estimate flow rate using control structures.
4. Design the most efficient channel section for carrying maximum discharge.
5. Develop models and perform studies for various hydraulic structures like dams, spillways, and barrages cross drainage works.
6. Build the necessary theoretical background for design of water resources systems.

**Topics Covered**

Unit 1 Basic Principles: open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows.

Unit 2 Uniform flow, roughness coefficient, computation of uniform flow in prismatic channel, design of non-erodible channels for uniform flow, Most efficient channel section, compound sections.

Unit 3 Gradually varied flow: Theory and analysis, gradually-varied flow computations in prismatic channels, gradually varied flow in non-prismatic channels. Rapidly varied flow: Theory of hydraulic jump, evaluation of jump elements in rectangular and non-rectangular channel, location of jump on horizontal floor, channel controls and transitions, free over fall, thin plate weirs, broad crested weirs, and sluice gates.

Unit 4 Application of model studies to free surface flow problems, waves and their classifications, celerity of a wave, surge formation, equation of motion, rapidly varied unsteady flows.

**Text Books and/or Reference Materials**

1. Subramanya, “Flow in Open channels”
2. K G Ranga Raju, “Flow through open channel”
3. V.T Chow “Open channel Hydraulics”
4. Bakhmeteff, “Hydraulics of open channel”

**Additional Learning Source**
1. Henderson, “Open channel flow”
2. Web links to e-learning: nptel
Civil Engineering | CE415 | Irrigation Engineering | DC | CE 414 | Theory | 4 | 3 | 1 | 0 | 4

Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 3 Hour

Course Objective
The main objective of this course is to understand the theory and design of irrigation structures in the Indian sub-continents. The course covers the major topics such as assessment of water requirement for various crops, design of canals, headwork, regulation works, cross drainage works and river training works etc. Various types of irrigation and related problems such as water alkalinity and water logging are also highlighted.
1. To understand the importance of the methods of irrigation which use lesser quantity of water for growing crops in more area.
2. To understand the significance of loss of water in maintaining water requirement of various crops for more yield of crops.
3. To understand the decrease in yield of crops due to water logging.
4. To understand the design of unlined and lined irrigation canal network for smooth conveyance of water from source to the field for cultivation of crops.
5. To understand the adverse impact of silting of canals in reducing the discharging capacity of canals i.e. the command of canals to design the silt control structures on canals and rivers. To understand the elementary idea of sediment transport in alluvial channels for proper design of earthen canals.
6. To understand the design of cross drainage structures for uninterrupted water supply in natural channels and manmade canals.
7. To understand the design of storage and diversion canal head works for diverting the water from rivers into the canals.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Realize the importance of optimal water use for growing the crops and apply methods for saving land from water logging.
2. Apply knowledge for efficient design methods for rapid conveyance of water with lesser loss in irrigation canals.
3. Apply the silt control devices in canals and natural channels for long life of irrigation schemes i.e. Silt excluders, Silt ejectors, Sediment transport in alluvial channels and reduction of channel resistance due to silt deposition on the bed and sides of canals.
4. Apply the knowledge in the design of hydraulic structures to be constructed at junction of natural and manmade channels with obstruction free flow.
5. Formulate irrigation networks across the country to make itself self reliant in food grain production.
6. Emancipate the need of water resource conservation and management to overcome the natural calamities such as drought.

Topics Covered
Unit 1 Irrigation development in India, present status of irrigation in India, methods of irrigation, land leveling and Irrigation schedule.
Unit 2 Silt control in canals, Water requirement of various crops, Canal losses, water-logging and lining of canals.
Unit 3 Regime theories for the design of earthen channels, elementary idea about sediment transport, incipient motion of sediment and modes of sediment transport.
<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. P.N. Modi, “Irrigation Water Resources and Water Power”</td>
</tr>
<tr>
<td>2. Bharat Singh, “Irrigation Engineering”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Web links to e-learning: nptel</td>
</tr>
<tr>
<td>Department</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. External Viva-Voce (40%)

**Course Objective**

1. To develop an appreciation of problems in the Design and Analysis of Buildings, Bridges and Special structures such as Retaining Walls, Chimneys, Silos, Large sized Water Tanks/ Water Treatment Plants etc.
2. To develop basic understanding of FEM softwares useful in the analysis and design of structures and structural elements
3. To impart training for handling such design projects
4. To have feel of real life situations in planning of such projects

**Course Outcomes**

1. Develop basic concepts of forces acting on simple structural elements and also the concept of combined stresses (3D stress state) in materials used in civil Engg.
2. Understand the behavior of simple (selected) structural elements under applied forces.
3. Recognize and be able to apply fundamental principles to check the stability of structural elements
4. Generate an ability to apply the knowledge of stress state in the design of structural elements
5. Build the necessary theoretical background for planning, estimation, and design of structures.

**Topics Covered/List of project titles in last three academic years**

**Session: 2013-14**

1. Design of a commercial complex
2. Design of a PACIFIC complex
3. Design of a G+4 storeyed building
4. Design of a 2-lane R.C Bridge
5. Analysis and Design of a Hospital Building
6. Design of a shopping mall/complex

**Session: 2012-13**

1. Analysis and design of Z-Square mall at Kanpur
2. Planning, analysis and design of Hospital building
3. Analysis and design of multi-storeyed convention centre
4. Design of R.C.C Bridge
5. Analysis and design of shopping mall
6. Analysis and design of a multi-storeyed commercial building

**Session: 2011-12**

1. Design of two lane highway T-Beam bridge
2. Planning, analysis and design of the terminal building of an airport
3. Analysis and design of multi-storeyed shopping complex
4. Analysis and design of multi-storeyed office building
5. Analysis and design of a multi-storeyed commercial building
6. Analysis and design of institution building
7. Analysis and design of hospital building
8. Analysis and design of shopping mall
9. Analysis and design of five star hotel building
10. Design of two lane T-Beam concrete bridge
11. Behaviour of RC Framed building with and without infills

**Text Books and/or Reference Materials**

4. Verghese, P.C. “Advance Reinforced Concrete Design” Prentice-Hall of India, New Delhi, India.
5. I.S: 456-2000- Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi, India.
10. S.P:34- Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi, India.

**Additional Learning Source**

1. George Winter “Design of Concrete Structures”, McGraw-Hill, USA
2. Kong and Evans “Reinforced and Prestressed Concrete”, ELBS, Low Priced Edition
3. Study through Journal Papers
Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CE494A/B | Project A/B (Geotechnical Engineering) | DC | CE312, CE391R, CE413, CE41 | Lab | 4 | 1 | 2 | 0 | 3

**Course Assessment Method**
1. Class Work (60%)
2. External Viva-Voce (40%)

**Course Objective**
1. To utilize the expertise in engineering to solve industry’s technological problems
2. To become innovative and professional in technology development, and system implementation
3. To understand, interpret and properly apply project results obtained using standardized method in the engineering of civil infrastructures.
4. To succeed in graduate studies and research
5. To be able to function in their profession with social awareness and responsibility
6. To be able to interact with their peers in industry and society as engineering professionals and leaders
7. Enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Design a foundation system, component, or process to meet desired needs within realistic, economic, environmental constraints.
2. Design and conduct experiments to determine index properties of soil, as well as to analyze and interpret data so obtained.
3. Interact with other streams of civil engineering in multidisciplinary system to manage geotechnical issues.
4. Predict behaviour of soil under actual field loading and safe design of embankments, building, dams, etc.
5. Identify, formulate and solve geotechnical engineering problems and to use techniques, skills and modern engineering tools necessary for engineering practice.
6. Understand the ethical and professional responsibility and to know how to write professional and concise technical reports.

**Topics Covered/List of project titles in last three academic years**

**Session: 2013-14**
1. Geotechnical investigations for railway over bridge
2. Geotechnical investigations for (G+4) multi-storeyed building

**Session: 2012-13**
1. Soil investigation and design of foundation of multi-storeyed building
2. Soil investigation and design of foundation of shopping mall

**Session: 2011-12**
1. Soil investigation and design of well and pile foundation of railway over bridge
2. Soil investigation and design of foundation of multi-storeyed building

**Text Books and/or Reference Materials**

**Additional Learning Source**

1. Journals related to Geotechnical Engineering
3. www.wiley.com/college/kalinski
### Course Assessment Method

1. Class Work (60%)
2. External Viva-Voce (40%)

### Course Objective

The basic aim of the project is to give a reasonable understanding of different aspects utilized in the design and construction of pavements by using different materials and methodology. Hence, this course has been designed to provide insight to the students about analysis, design and construction, collection of data, making drawing, cost estimation and writing report in highway engineering.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concepts of Mathematics and Law of Mechanics to the analysis and design of highways.
2. Design and conduct experiments on pavement materials, as well as to analyze and interpret data.
3. Work in multi disciplinary teams in a highway project.
4. Communicate effectively related to specific topic on Highway Engineering
5. Apply condition monitoring and maintenance of road pavements.
6. Conduct laboratory and field testing for design of pavements and overlays especially in case of bituminous constructions.
7. Develop technical skills for maintenance of flexible and rigid pavements.
8. Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes.

### Topics Covered/List of project titles in last three academic years

**Session: 2013-14**

1. Design of rigid and flexible pavements resting on geofibre reinforced subgrade soil

**Session: 2012-13**

1. To develop job mix formula for sub-base, base course and main course as per specification given in ministry of shipping, road and transportation
2. A software package for the design of pavements as per the codal provisions of IRC:37-2001 & IRC:58-2002

**Session: 2011-12**

1. Design of Flexible and Rigid Pavements on fly ash mixed with electroplating waste sludge and reinforced with geo-fibre
2. Design of Flexible and Rigid Pavements on lime treated, geo-fibre reinforced flyash subgrade

### Text Books and/or Reference Materials


### Additional Learning Source

1. Journals related to Geotechnical/Transportation Engineering
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE494A/B</td>
<td>Project A/B (Environmental Engineering)</td>
<td>DC</td>
<td>CE111 CE313N CE392R</td>
<td>Lab</td>
<td>4</td>
<td>1 2 0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. External Viva-Voce (40%)

**Course Objective**

1. To inculcate the ability to handle environmental problems as a whole including planning and design.
2. To develop the ability to critically understand and analyse specific problems related to environmental protection.
3. To develop the ability to identify, formulate and solve environmental engineering problems.
4. To develop the ability of working in the groups and to develop skills related to comprehensive report writing.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Identify and select the relevant environmental problems.
2. Use the laboratory equipments for the testing and analysis of water/wastewater, solid waste, air etc.
3. Understand the limitations of different technologies involved in the solution of environmental problems.
4. Design and analyse experiments.
5. Write comprehensive reports, project outcomes and shortcomings.

**Topics Covered/List of project titles in last three academic years**

**Session: 2013-14**
1. Biological removal of Nutrients from Domestic Wastewater
2. Treatment of Slaughterhouse water by Advanced Oxidation Process
3. Treatment of Sugar Mill Wastewater by Anaerobic Hybrid Reactor
4. Treatment of Distillery wastewater by Anaerobic Hybrid Reactor

**Session: 2012-13**
1. Post Treatment of Pulp and paper Mill wastewater by Sequencing Batch Reactor

**Text Books and/or Reference Materials**

1. Handbooks and Design Manuals of Water and wastewater Treatment
2. Comprehensive Industry Documents of Central Pollution Control Board and other relevant codes.

**Additional Learning Source**

1. Journals related to Environmental Engineering
### Course Assessment Method

1. Class Work (60%)
2. External Viva-Voce (40%)

### Course Objective

1. To benefit the students employed in any concern in formulating the proposal for a new project development in irrigation engineering and water resources engineering.
2. To understand the planning, formulating, data collection, evaluation and environmental considerations of different irrigation and water resources projects.
3. To apply the engineering economics in the economical analysis of various alternatives of water resources planning and development projects.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the preparation of the proposal of an irrigation and water resources project approval from the government.
2. Understand the importance of collection of reliable data for preparing the proposal.
3. Apply the knowledge of economical analysis for searching the best suited and economically viable project alternative.

### Topics Covered/List of project titles in last three academic years

**Session: 2013-14**
1. Roof top rain water harvesting for Faculty of Engineering and Technology, AMU, Aligarh.

**Session: 2012-13**
1. Rooftop Rain water Harvesting for Medical Colony A.M.U., Aligarh, A Case Study.
2. Proportioning of barrage.
3. Design of gravity dam on spread sheet.

**Session: 2011-12**
1. Design of cross and head regulators of canal.

### Text Books and/or Reference Materials

1. P.N. Modi, “Irrigation Water Resources and Water Power”
2. Bharat Singh, “Irrigation Engineering”
5. K G Ranga Raju, “Flow through open channel”

### Additional Learning Source

1. Journals related to Hydraulics Engineering
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE291R</td>
<td>Civil Engineering Materials Lab</td>
<td>DC</td>
<td>None</td>
<td>Lab</td>
<td>2</td>
<td>0 1 2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. The objective of this course is to understand the characteristics and behavior of civil engineering materials used in buildings and infrastructure.
2. Students will learn standard principles and procedure to design prepare and/or test materials such as concrete mix design including field test methods for fresh concrete.
3. Students will know how to select materials based on their properties and their proper use for a particular facility under prevailing loads and environmental conditions.
4. Students will have exposure to practical applications including writing of a technical report related to each experiment.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Demonstrate ability to make selection of materials based on their properties, behavior and intended use in design and construction.
2. Write formal technical report & convey engineering message efficiently.
3. Understand ethical issues associated with engineering experiments and professional practice.
4. Collaborate lab work in groups and divide responsibilities among group members.
5. Determine the normal consistency, Initial & final setting times and compressive strength of Portland cement.
6. Determine the gradation, silt content, unit weight and specific gravity of coarse and fine aggregate samples.
7. Prepare and test concrete specimens in fresh and hardened state to determine the slump value, compaction factor and compressive strength of concrete to be used at site.
8. Evaluate, statistically analyze and interpret laboratory test results.

**Topics Covered/List of Experiments**

- **Test on Cement**
  1. Normal Consistency of Cement
  2. Setting Time of Cement
  3. Compressive Strength of Cement

- **Test on Aggregate**
  1. Silt Content in Fine aggregate
  2. Bulking of Sand
  3. Particle Size Distribution of Coarse and Fine Aggregate by Sieve Analysis

- **Test on Fresh Concrete**
  1. Workability of Concrete by Slump Test and Compaction Factor Test

- **Test on Hardened Concrete**
  1. Effect of W/C Ratio on Crushing Strength of Concrete

**Text Books and/or Reference Materials**

1. Lab manual provided by the department
2. Neville, A.M., “Properties of Concrete”, Longman, India
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Shetty, M.S., “Concrete Technology”, SCC Ltd., New Delhi</td>
</tr>
<tr>
<td><strong>Additional Learning Source</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Gambhir, M.L., “Concrete Technology”, TMH, New Delhi, India</td>
</tr>
<tr>
<td>Department</td>
<td>Course No.</td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>CE292R</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
The main objective of this lab course is to make the students in better understanding of fluid mechanics phenomena such as variation of velocity and pressure, measuring head loss in terms of differential head, liquid jet forces acting on various type of vanes and measurement of flow rate by various devices such as orifice meter, weir etc.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Design intricacies of hydraulic structures such as dams, spillways, weirs, sluice gate etc.
2. Design water and waste water disposal system.
3. Design and select appropriate rotodynamic system.
4. Use appropriate type of flow measuring devices.

**Topics Covered/List of Experiments**
1. Flow over weirs and notches
2. Verification of Bernoulli’s Theorem
3. Discharge through an Orifice
4. Centre of Pressure
5. Impact of Liquid jets
6. Head losses through sudden contraction and enlargement

**Text Books and/or Reference Materials**

**Additional Learning Source**
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Designation</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE294R</td>
<td>Structural Mechanics Lab</td>
<td>None</td>
<td>DC</td>
<td>Lab</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To learn about the material property toughness or the energy absorbing capacity before failure
2. To learn how to find transverse modulus of elasticity which is very useful in beams
3. To learn how a long column buckles under vertical load
4. To verify theoretical and practical bending moments
5. To learn how to find out shear modulus by plotting torque twist diagram
6. To learn about the material property hardness of different materials

**Course Outcomes**

Upon successful completion of this course, it is expected from students that they will be able to know the practical significance of each experiment and the following:
1. Toughness or the energy absorbing capacity of different materials
2. Transverse modulus of elasticity which is very useful in beam’s bending
3. Buckling of long columns
4. Effect of load and span on bending moment
5. Torque twist behaviour of cylindrical specimen
6. Hardness property or the resistance to surface indentation
7. Behaviour of a mild steel bar under tension

**Topics Covered/List of Experiments**

Experiment No. 1: To determine the impact value of the given specimens by Izod impact testing machine
Experiment No. 2: To determine the transverse modulus of elasticity by plotting the load deflection curve
Experiment No. 3: To determine the buckling load on columns for different end conditions
Experiment No. 4: Verification of bending moment and shear force in beams
Experiment No. 5: To determine the shear modulus by plotting the torque twist diagram for a circular shaft
Experiment No. 6: To determine the Brinell’s Hardness number for different materials
Experiment No. 7: To understand the behaviour of a mild steel bar under tension by plotting stress-strain curve

**Text Books and/or Reference Materials**

1. Lab manual provided by the department

**Additional Learning Source**

1. Mechanics of material by B. C. Punmia
2. Solid Mechanics by S.M.A. Kazmi
3. Web
Civil Engineering | CE295R | Surveying Lab | DC | None | Lab | 2 | 0 | 1 | 2 | 3

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveying Lab</td>
<td>DC</td>
<td>None</td>
<td>Lab</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Course Assessment Method
1. Class Work (60%)
2. End Semester Examination (40%)

Course Objective
1. To apply knowledge of mathematics, science, and engineering to understand the measurement techniques and equipment used in land surveying.
2. To gain an appreciation of the need for lifelong learning through the discussion of recent changes in survey procedures and equipment.
3. To use techniques, skills, and modern engineering tools necessary for engineering practice.
4. To function as a member of a team.
5. To understand the importance of professional licensure to protect the public in the practice of cadastral surveying.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Appreciate the need for accurate and thorough note taking in field work to serve as a legal record.
2. Use modern survey equipment to measure angles and distances.
3. Gain the ability to measure differences in elevation, draw and utilize contour plots, and calculate volumes for earthwork.
4. Gain a basic understanding of the principles and operation of the working of Total Station.
5. Improve ability to function as a member of a survey team in completing the assigned field work.
6. Appreciate the need for licensed surveyors to establish positioning information for property and structures.

Topics Covered/List of Experiments
1. Plane tabling by radiation method
2. Plane tabling by intersection method
3. Solution of two and three point problems by resection method
4. Differential Levelling
5. Longitudinal levelling and Cross sectioning
6. Measurement of horizontal and vertical angles with a theodolite
7. Determination of gradient of a line using stadia and tangential tacheometry
8. Analytical solution of three point problem and determination of the omitted portion of a base line
9. Determination of the height of an object by trigonometrical observations
10. Setting out of a simple curve
11. Setting out of a Building
12. Total station surveys (control establishment and detail plotting)

Text Books and/or Reference Materials

Additional Learning Source
1. Web links to e-learning: nptel
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE384R</td>
<td>Survey Camp</td>
<td>DC</td>
<td>CE 218R</td>
<td>Field Camp</td>
<td>2</td>
<td>6-Day Field Visit</td>
<td>6-Day Field Visit</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Field Work (60%)
2. Viva-Voce Examination (40%)

**Course Objective**

1. To work extensively on the different branches of surveying, namely traverse survey, levelling and plane table survey
2. To get a knowhow of the different field based problems related to the survey of the area and to propose solutions
3. To impart a comprehensive knowledge of the state of the art instruments used in surveying.
4. To understand the field problems related to the preparation of topographical map of an area
5. To train students to work in groups.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Assess the nature of the field area, for the planning and construction of any engineering project
2. Acclimatize with a variety of survey instruments.
3. Prepare detailed topographical map of the area that would be helpful in planning of engineering projects.
4. Estimate the volume of earthwork required and to plan the layout of engineering projects like roads, canals, sewers, etc.
5. Recognise the importance of time management in achieving a targeted work

**Topics Covered/List of Experiments Covered**

1. Traversing by Theodolite and Tacheometer
2. Latitude and Departure
3. Plane Table Survey
4. Differential Levelling
5. Longitudinal and Cross-Sectioning
6. Contouring
7. Total Station Based Surveys

**Text Books and/or Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: nptel
Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours L | T | P | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CE389 | Colloquium | DC | EN101 EZ291 | Theory | 2 | 0 | 1 | 2 | 3

**Course Assessment Method**

1. Minor Presentation (40%)
2. Major Presentation (60%)

**Course Objective**

1. To encourage the students to read, study and understand articles published in literature
2. To help in presenting different topics of civil engineering and related subjects to supplement theoretical knowledge gained in class
3. To acquire good oral and written communication skills
4. To promote the habit of life-long learning
5. To prepare students develop adequate soft skills to be able to present their topic effectively to listeners

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Analyse and interpret about contemporary issues in civil engineering and allied areas through literature survey.
2. Know about state of the art and relevance of the topic in national and international arena.
3. Demonstrate good oral and written communication skills.
4. Comprehend problems and accordingly speak and defend their topic.
5. Produce poster and power point presentations for effective communication amongst stakeholders.

**Topics Covered**

1. Any relevant topic related to civil engineering from within or beyond the syllabus

**Text Books and/or Reference Materials**

1. Websites relevant to the field of study selected

**Additional Learning Source**

1. Paper presented in Journals of Civil Engineering
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE391R</td>
<td>Soil Mechanics Lab</td>
<td>DC</td>
<td>None</td>
<td>Lab</td>
<td>2</td>
<td>0 1 2</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To introduce soil mechanics laboratory techniques to civil engineering undergraduate students.
2. To familiarize students with common geotechnical test methods, test standards and technology.
3. To understand, interpret and properly apply laboratory results obtained using standardized method for construction of structures.
4. To understand the analytical techniques for understanding (a) Darcy’s law for permeability and seepage (b) Stoke’s law for hydrometer analysis of particle size distribution of cohesive soils (c) Mohr-Coulomb’s analysis for shear strength parameters of soils.
5. Enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Classify the soils and predict its behavior in terms of mechanical properties i.e. strength, compressibility and permeability.
2. Predict behavior of soil under field loading for safe design of structures over or under the soil.
3. Quantify the mechanical properties of soil based on standardized laboratory tests.
4. Analyse and Design a variety of geotechnical engineering structures including foundations, piles, retaining walls, slopes and interpret data for different laboratory/field conditions.

**Topics Covered/List of Experiments**

1. Specific Gravity by Density Bottle and Pycnometer
2. Field Density by Core Cutter Method
3. In-Situ Density of Natural Soil by the Sand Replacement Method
4. In-Situ Density of Soil by Sand Replacement Method
5. Sieve Analysis
6. Permeability by Constant Head Test
7. Permeability by Falling Head Test
8. Proctor’s Compaction Test
9. Shear Strength by Triaxial Shear Test (Demonstration)
10. Shear Strength by Direct Shear Test (Demonstration)

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE392R</td>
<td>Environmental Engineering Lab</td>
<td>DC</td>
<td>CE 111</td>
<td>Lab</td>
<td>2</td>
<td>0   1   2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To learn the handling of different equipments related to water and wastewater analysis
2. To learn about the preparations of stock and standard solutions, their handling, storage, etc.
3. To understand the different experiments involved in water and wastewater analysis.
4. To learn more about the titration techniques of chemical analysis
5. To develop skills related to report writing.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Characterize water and wastewater samples
2. Predict the quality of treated water and wastewater samples
3. Evaluate the efficiencies of the water and wastewater treatment plants.
5. Select the appropriate technologies for wastewater treatment

**Topics Covered/List of Experiments**
1. Determination of pH and Alkalinity of Water and Synthetic solution.
3. Determination of optimum Alum Dose by Jar Test Apparatus.
4. Determination of available Chlorine in Bleaching Powder
5. Determination of Residence time for PFTR
6. Determination of Oxygen Transfer Capacity of the Laboratory aeration system
7. Determination of BOD
8. Determination of COD
9. Determination of Sulphates

**Text Books and/or Reference Materials**
1. Laboratory Manual of Environmental Engineering provided by the department

**Additional Learning Source**
1. Web links related to Environmental Engineering and Environmental Engineering Lab
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE395R</td>
<td>Steel Design Practice Lab</td>
<td>DC</td>
<td>ME 111</td>
<td>Lab</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

Student is expected to know the basics softwares of drawing and design (AUTOCAD AND STAAD -Pro). The course focuses on understanding the behaviour of steel structural components subjected to gravity loads:

1. Design of axially loaded compression members and built up members
2. Design of lacings and battens
3. Design of column bases and grillage foundations
4. Design of flexural members, plate girder and its components
5. Design of roof trusses and its components
6. Course work includes submission design sheets. Use of AUTOCAD for drawings.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Recognize the design philosophy of the steel structures
2. Understand the structural behaviour of different steel structural elements and their analysis
3. Analyze and design different elements of steel structural elements under gravity loads and submit the designs in complete and concise manner.
4. Use the techniques, skills, and modern engineering tools necessary for design and detailing.
5. Analyze and interpret the results using analytical tools and further plan design and detail different civil engineering structures.
6. Design a structure/component, to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability as per the codal provisions.

**Topics Covered/List of Experiments**

1. Design a built up column 10m long to carry an axial load of 1000 kN. The column is restrained in position but not in direction at both ends. Design the columns with channels placed back to back and the battens. *(Week 1)*
2. Design a plate girder section of an effective span (16 + S.No./5) metres and simply supported at its ends. It carries a distributed load of (50 + S.No./2) kN/m and two concentrated loads of 800 kN at 4m from each support. The girder is effectively supported in lateral direction. Use IS: 800-2007 *(Week 2, 3 & 4)*
3. Design a built up column carrying an axial load of 1400 kN. Its length is 7m, and it is effectively held in position at both ends and restrained against rotation at one end. Assume a yield stress of 250 MPa. Design a lacing system for the columns. *(Week 5)*
4. Design a two tier grillage foundation for two columns to carry 1000 kN, the base of the stanchion is 6000 mm². The earth pressure is to be limited to a value of 1800 kN/m². Sketch the details of the foundation. *(Week 6 & 7)*
5. Design a roof truss for a clear span of 14.66m to serve as a roof for a gymnasium. The truss is to be supported on 14” brick wall. The building is situated at Aligarh. The average height of roof is 10m. The roof covering will consist of G.I sheets. Analyse using STAAD 2006 and design the truss. Show details of the truss. *(Week 8, 9 & 10)*

**Text Books and/or Reference Materials**

3. K.S. Sairam “Design of Steel Structures”, Pearson, Delhi, India
5. Kazmi, S.M.A and Jindal R.S “Design of Steel Structures” PHI, New Delhi, India
6. Arya and Ajmani “Design of Steel Structures”, NCB, Roorkee, India
7. Ram Chandra “Design of Steel Structures”, Vol. I & II, Standard Book house Delhi, India
8. I.S: 800-2007- Code of Practice for General Construction in Steel, BIS, New Delhi, India
9. I.S: 808-1989- Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections, BIS, New Delhi, India

Additional Learning Source

1. Web links to e-learning: nptel and insdag
Civil Engineering | CE396R | Hydraulics Lab | DC | CE 213 CE292R | Lab | 2 | 0 | 1 | 2 | 3

**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To study the law of resistance and estimate the pipe friction factor
2. To train the students to calibrate flow measuring instruments
3. To apply the concepts of viscous flow theory in the field of viscometer
4. To visualize various types of flow in pipe
5. To apply the concepts of normal and tangential acceleration in pipe bend for flow measurement

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Solve the laminar and turbulent pipe flow problems
2. Calibrate any flow measuring devices
3. Apply Stokes law in design of a settling tank
4. Apply the theory of laminar flow for development of viscometer
5. Apply the visualization technique in understanding of mechanics of flow
6. Utilize pipe bend as a meter for discharge measurement in a pipe

**Topics Covered/List of Experiments**
1. Flow through pipes
2. Flow through Venturimeter
3. Determination of viscosity by capillary tube viscometer
4. Determination of viscosity by falling sphere viscometer
5. Flow visualization using Reynolds apparatus
6. Flow through bend meter

**Text Books and/or Reference Materials**

**Additional Learning Source**
2. Web links to e-learning: nptel
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE397R</td>
<td>Transportation Engineering</td>
<td>DC</td>
<td>CE213 CE292R</td>
<td>Lab</td>
<td>2</td>
<td>0 1 2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To carry out tests on construction materials for their suitability and economic utilization.
2. To identify and classify the pavement materials into different groups according to their characteristics.
3. To make aware the students about the classification, suitability, strength and stability of pavement materials.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Monitor and maintain road pavements.
2. Develop insight for characterization of materials for highways and railways.
3. Develop Job mix for various types of bituminous constructions such as WMM, SDBC, BC, DBM and BM etc.
4. Develop technical skills for pavement and rail construction.
5. Prepare the testing reports related to highway engineering works.
6. Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes.

**Topics Covered/List of Experiments**

1. California bearing ratio test on subgrade soil sample.
2. Determination of hardness of stone by Los Angles abrasion test.
3. Determination of toughness of stone by impact test.
4. Specific gravity and water absorption of stone aggregate.
5. Flakiness and elongation indices tests on stone aggregate.
6. Soundness test on stone aggregate.
7. Deval attrition test on stone aggregate.
8. Crushing strength test on stone aggregate.
9. Ductility test on bitumen.
10. Softening point test on bitumen.
11. Flash and fire point test on bitumen.
12. Penetration needle test on bitumen.
13. Viscosity test on bitumen.
14. Bituminous mix design by Marshall stability test (Demonstration)

**Text Books and/or Reference Materials**


**Additional Learning Source**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE488R</td>
<td>Professional Training</td>
<td>Knowledge of relevant subjects in which training is pursued</td>
<td>Training</td>
<td>1</td>
<td>1 Month Field Training</td>
<td>30 days</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Through viva-voce on training report submitted by the students.

**Course Objective**

1. To develop an appreciation and importance of civil Engineering in developing the infra structure.
2. To develop an understanding regarding the various engineering principals to be used in the field construction activities.
3. To emphasizes on the use of the modern tools and plants used in the construction industry.
4. To develop a technical skill to prepare project documents.
5. Build the necessary practical background and exposure to the field problems.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the fundamental concepts of civil engineering, its necessity and importance.
2. Apply the knowledge in selecting suitable materials, and construction technique required for a particular construction activity.
3. Understand the significance of various suitable tools and plants to be used as per the given site conditions.
4. Execute and handle the projects individually and on team basis.
5. Manage the various activities of a construction project.

**Topics Covered**

Field Training done in any area related to civil engineering

**Text Books and/or Reference Materials**

Knowledge of all core subjects related to the desired training program

**Additional Learning Source**

On-field training
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE491R</td>
<td>Concrete Design Practice Lab</td>
<td>DC</td>
<td>CE 311 CE411</td>
<td>Lab</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

The objective of the course is to make students skillful in designing & detailing of everyday structure along with the reference practice to various IS codes and specification. This course in helpful to students in two ways:

Firstly, it directly helps a student who opts for a career in design practice after completing his graduation. Secondly, it is useful for those students also who wish to enter in the field work/ construction to earn their living. If the students has persuaded this course with devotion & sincerity then he will not have any difficulty in preparing working drawing for any job work or he can very well understand the design of his drawing for execution purposes & can realize the mentioned specification in the work during execution.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply the principle of physical sciences & skills of engineering to give a feasible solution to any problem faced during design& execution.
2. Analyze and incorporate in the design / modify the data in the solution e.g. value of loads taken in design and use of human skills in the functional design of structure.
3. Develop an ability to understand various ethical & social constraints e.g. constructability principles exposure of the structure to various types if environment abuses.
4. Develop an ability to work in a team with objective of achieving the goal and develop sportsman spirit.
5. Develop and inculcate engineering sense so that an engineer can apply engineering and technological knowledge & skills in the solution of problem which he had never encountered.
6. Learn ethics & responsibility of a design engineer to give optimal design of any structure.
7. Present their design at various stages right from understanding the problem, preliminary design analysis and final section recommendation, writing of material & construction specification & good construction practices for any of the job designed.
8. Develop a broad understanding of the engineering solution & design incorporating the economic constraints and social impacts.
9. Learn by doing & day to day learning as they are the corner stone of professional practice.
10. Realize gravity of standardization.
11. Develop consumptive utility in design practice.

**Topics Covered/List of Experiments**

Design & Detailing of following structures:
1. Beam, slab, column and foundation
2. Slab culvert
3. Rectangular water tank, Intze tank

**Text Books and/or Reference Materials**

1. Various codes & standards
2. Handbooks
3. Observation and Inferences from existing structures

**Additional Learning Source**
1. Ready references from internet e.g. site of RIBA (Royal Institution of British Architect), ACI codes.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE492R</td>
<td>Structural Lab</td>
<td>DC</td>
<td>CE 315</td>
<td>Lab</td>
<td>2</td>
<td>0 1 2</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To learn where to load the unsymmetrical sections
2. To learn how to find forces in different members of the truss
3. To learn how to use compatibility equations & compare the deflections in perfect & redundant trusses
4. To learn how to find modulus of elasticity for brittle materials
5. To learn how a beam deflects in pure bending under one & two point loading
6. To learn how to make use of non destructive testing methods

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Load the unsymmetrical sections at proper locations to avoid shear stresses
2. Know different methods of finding forces in the members of a truss
3. Know that redundant trusses carry more loads in comparison to the perfect trusses
4. Plot stress strain diagram and find modulus of elasticity by offset method
5. Find deflections at different locations of the beam
6. Use PUNDIT and rebound hammer for finding compressive strength of concrete

**Topics Covered/List of Experiments**

Experiment No. 1: To determine the shear centre for unsymmetrical sections.
Experiment No. 2: Study of stress in pin jointed trusses.
Experiment No. 3: Verification of compatibility equation and comparison of deflections of a Perfect and Redundant truss.
Experiment No. 4: Determination of modulus of elasticity of mild steel bar by simple tensile test.
Experiment No. 5: Load deflection test on simply supported MS I section under flexure.
Experiment No. 6: Assessment of strength of concrete cubes using non-destructive tests.

**Text Books and/or Reference Materials**

1. Lab manual provided by the department

**Additional Learning Source**

1. Basic Structural Analysis by C.S. Reddy
2. Mechanics of materials by B. C. Punmia
3. Structural Analysis (Vol.1 & 2) by Vazirani and Ratwani
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE493N</td>
<td>Design of Irrigation Works</td>
<td>DC</td>
<td>CE415</td>
<td>Lab</td>
<td>2</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. Give thorough idea of designing and detailing of some typical irrigation structures.
2. To understand the significance of efficient and proper design of irrigation works (a) Earthen canals (b) Lined Canals (c) Stable alluvial channel (d) Canal regulation structures (e) Cross drainage works (f) Diversion headworks
3. To understand the effect of uplift pressure in the design of hydraulic structures on permeable soils.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Understand the concept of sustainable design of hydraulic structures on permeable foundations and to understand the effects of seepage.
2. Understand the importance of proper detailing in the drawings of hydraulic structures.
3. Apply knowledge in execution of laying out and construction of hydraulic structures on permeable foundations.

**Topics Covered/List of Experiments**

**Week 1**: General Instructions about the designs to be done in the lab
**Week 2**: Practice on Khosla’s charts
**Week 3**: Problem on uplift pressure calculation using Bligh’s theory
**Week 4**: Problem on uplift pressure calculation using Khosla’s theory
**Week 5**: Practice on energy curves
**Week 6**: Design of earthen canals using Kennedy and Lacey’s Methods
**Week 7**: Design of lined canals including cost-benefit analysis
**Week 8**: Design of Sarda fall for discharge <14 cumecs
**Week 9**: Design of Sarda fall for discharge >14 cumecs
**Week 10**: Design of an aqueduct and siphon aqueduct

**Text Books and/or Reference Materials**

1. P.N. Modi, “Irrigation Water Resources and Water Power”
2. Bharat Singh, “Irrigation Engineering”

**Additional Learning Source**

1. K G Ranga Raju, “Flow through open channel”
## Departmental Electives Courses

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE421</td>
<td>Concrete Technology</td>
<td>DE</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

### Course Objective

After studying this course, students will be able to:

1. Determine the properties of concrete ingredients i.e. cement, sand, coarse aggregates, water by conducting different tests.
2. Use different types of cement as per their properties for different field applications.
3. Design economic mix proportion for different exposure conditions and intended purposes.
4. Supervise various concrete operations.
5. Carry out field tests on concrete in fresh and hardened state.
6. Use different types of admixtures to improve the properties of concrete for different field applications.
7. Describe different types of concrete.
8. Infer the test results as per relevant IS provisions.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Describe the materials used to make concrete, including their sources, production and properties.
2. Explain the properties of fresh concrete.
3. Explain the properties of hardened concrete including strength and durability.
4. Design normal concrete mixes and apply statistical quality control techniques to concrete quality.
5. Explain how good concrete is produced.
6. Identify, describe and carry out the main laboratory tests relevant to the use of concrete on site.

### Topics Covered

- **Unit 1** Fresh Concrete: Properties of its Ingredients, Production of Concrete, Properties and Quality Control, Mix Design.
- **Unit 2** Strength of Hardened Concrete: Effect of W/C Ratio, Aggregate /Cement ratio, Stress-Strain Characteristics, Effect of Age, Fatigue & Impact Strength, Shrinkage, Creep and Porosity.
- **Unit 3** Behaviour of Concrete in Extreme Climate: Permeability & Durability, Temperature Problems in Concreting, Saline Environment, Sulphate & Acid Attack, Fire Resistance.
- **Unit 4** Testing of Concrete: Test on Fresh & Hardened Concrete, Non Destructive Test.
- **Unit 5** Special Concretes: Light Weight Concrete, High Density Concrete, Pre-Placed Concrete, Fibre Reinforced Concrete, Ferro-cement, Polymer Concrete, Air Entraining Concrete, Role of Admixtures.

### Text Books and/or Reference Materials

1. Neville, A.M., “Properties of Concrete”, Longman, India
3. Shetty, M.S., “Concrete Technology”, SCC Ltd., New Delhi
4. I.S: 456-2000- Code of Practice for Plain and Reinforced Concrete
6. S.P.:23- Handbook on Concrete Mixes

### Additional Learning Source

97
1. Gambhir, M. L., “Concrete Technology”, TMH, New Delhi, India
2. Web links to concrete technology, Nptel etc.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE425</td>
<td>Advanced Hydrology</td>
<td>DE</td>
<td>CE 219</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop a concept of meteorology, probable maximum precipitation, depth-area-duration relationships, frequency of point rainfall, intensity-duration-frequency relationship.
2. To discuss the importance and application of Statistics and probability in hydrological analysis.
3. To develop an understanding of various methods of flood estimation in general and flood frequency in particular.
4. To develop the concept of flood routing through reservoir and channel and its application in flood forecasting and flood control.
5. To study various types of hydrographs such as instantaneous unit hydrograph, Bernard’s distribution graph and its application to flood estimation and flood forecasting.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply the knowledge in estimation of discharge for designing a drain, culvert etc.
2. Apply statistical knowledge in modeling of random process
3. Estimate the flood discharge for planning and management of water resources projects
4. Apply the flood routing techniques in designing river protection works and implementing the various types of flood control measures
5. Apply the various concepts of hydrograph in the watershed management

**Topics Covered**

Unit 1 Water availability, Meteorology, Probable maximum precipitation, Depth area duration relationships, Frequency of point rainfall, Intensity Duration frequency relationship.

Unit 2 Flood estimation and flood routing: General, Design flood, estimation for ungauged and gauged water sheds, probable maximum flood, Routing classification, Reservoir routing, Hydrological Channel routing.

Unit 3 Statistics in Hydrology: General probability distributions, Moments of distribution, Distribution characteristics, Forms of Probability distributions, frequency Analysis, Reliability of Statistical analysis, fitting of a Probability distribution.

Unit 4 Unit Hydrograph, Unit Hydrograph for ungauged water sheds, Instantaneous Unit Hydrograph, Bernard’s distribution graph.

**Text Books and/or Reference Materials**


**Additional Learning Source**

1. NPTEL course materials from different IITs.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours L</th>
<th>T</th>
<th>P</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE427</td>
<td>Geo-Engineering of Rocks and Rock Mass</td>
<td>DE</td>
<td>CE215</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

Geo-engineering of Rocks and Rock Mass, has been designed to give emphasis more on the engineering aspect as compared to geology and to act as the bridge course for the students offered M. Tech. by different IITs on “Underground Construction” or “Rock Mechanics”. It will help in developing:

1. Concepts of rock mass properties governed by deformation of rocks and development of discontinuity features.
2. Insight to presence of insitu and forced stresses in rock mass, their measurement will be able to solve engineering problems.
3. Safe excavation techniques for construction of underground structures.
4. Knowledge of ground improvement techniques with special reference to rock mass.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand geotechnical properties of rocks within the framework of fundamental concepts of basic sciences and with emphasis on their practical utility in civil engineering.
2. Learn about various natural inherent weaknesses in rocks and rock masses, their quantification and its use in designing.
3. Justify importance of residual stresses in rock mass and to model the redistribution of stresses during loading and unloading.
4. Model physical and mechanical properties of rocks and rock mass through quantification.
5. Identify and predict future behavior of founding ground and accordingly build necessary database for design and construction.
6. Interact with stakeholders in mega construction project and to be aware of more advanced techniques and state of the art technology available for unusual problems.
7. Recognize the importance of good written communication skills, and know how to write professional, clear, concise technical reports and letters to clients and colleagues.

**Topics Covered**

**Unit 1** Rocks and its Physical Properties:
- Genetic and mineralogical classification of rocks
- Mode of occurrence, form, and structure of rocks
- Rock textures, grain size parameters and petrological fabric of rocks
- Effect of physical, chemical weathering and deterioration of rocks

**Unit 2** Natural Forces and Deformation of Rocks:
- Genesis of natural forces and theory of plate tectonics
- Folds: mechanics, classification and effects of folding
- Faults: mechanics, classification and effects of faulting
- Joints: mechanics, classification and effects of jointing
- Shear zones, rock cleavage and tectonites

**Unit 3** Mechanical Properties of Rocks and Tests:
Factors controlling the mechanical properties of rocks
Density, porosity, sorption and permeability of rocks
Elasticity, compressive, shear and tensile strength of rocks
Engineering performance of rocks

Unit 4 Geo-Engineering of Rock Masses and Tests:
Discontinuities in rocks and rock mass fabric
Interstitial water and seepage flow in rock mass
Residual stresses, creep and rheological behavior of rock mass
Geomechanical classification and geotechnical description of rock masses
Insitu tests for deformability and strength of rock mass

Unit 5 Methods of Rock Mass Investigation and Improvement:
Geological mapping and engineering geology maps
Exploration pits, trenches, drifts and drilling
Rock mass problems in slopes, excavations and underground openings
Rock mass improvement, grouting, guniting, cable anchors and rock bolting

Text Books and/or Reference Materials

Additional Learning Source
1. Websites related to Mega Engineering Projects
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE428</td>
<td>Dam Engineering</td>
<td>DE</td>
<td>CE 219, CE 415</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop an appreciation of needs and importance of dams in Indian perspective.
2. To develop an understanding regarding the various materials to be used in the dam construction.
3. To build the necessary theoretical background for the selection of a suitable site for a dam and a suitable dam for a given site location.
4. To emphasize on the basic design principle of the gravity dam, earthen dam, arch and buttress dam.
5. To develop technical skills to prepare water resource project documents by using the various design parameters based on the knowledge of elementary profile.
6. To solve numerical problems on stability analysis of low and high gravity dams.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Understand the fundamental concepts of dam engineering, its necessity and importance.
2. Apply the knowledge in selecting a suitable materials, site and a suitable dam for the given site conditions.
3. Understand the significance of various forces acting on gravity dams.
4. Estimate forces acting on dams under various design conditions and earthquake zones.
5. Design the economical section for a gravity dam corresponding to a given full reservoir level.
6. Create the necessary theoretical background for design of water resources projects.

**Topics Covered**

Unit 1 Types of Dam, merits and demerits, dam site selection, selection of dam, Forces acting on gravity Dam, Methods of analysis of gravity Dam, Modes of failure and stability requirements, Design criteria and factor of safety.

Unit 2 Elementary profile of a gravity dam, Low and high gravity dams, Zoning of dams, Galleries in dams, Temperature control in mass concrete; gravity dams subjected to earthquakes.

Unit 3 Buttress and Arch dams, Types, selection, merits and demerits, Elementary design Principles of Arch and Buttress dams.

Unit 4 Earth Dam their component and functions, causes of failure. Factors influencing the design of an earth dam. Design criteria for Earth Dam. Elementary idea of design for spillway and energy dissipaters.

**Text Books and/or Reference Materials**

1. R.S. Varshney “Concrete Dams”, by 1982, NCB, Roorkee
2. Design of Small Dams, USBR 1960, Calcutta, Oxford and IBH

**Additional Learning Source**

1. NPTEL course materials from different IITs.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE429</td>
<td>Industrial Pollution Control</td>
<td>DE</td>
<td>CE 111</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**
1. To impart fundamental training and knowledge about the science & engineering of the industrial pollution
2. To develop basic understanding about the pollution types, its effects on the environment & human health, and their control measures.
3. To give students an in-depth importance and understanding of the severity of the industrial pollution and processes involved in the treatment of wastewater, and control of air pollution.
4. To train the students to present a case of any industry and its environmental management programme to build a direct transition in between the theory and practical.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Differentiate between environmental sciences, engineering and industrial pollution control
2. Address the importance of the environment in general and may apply fundamental concepts of Environmental Engineering & Sciences for any industry in their career.
3. Capable to face challenges and apply their knowledge in the areas of industrial infrastructure, and environmental remediation.
4. Hands-on basic design procedure, case studies, seminars, and short-trips provide an understanding of the problems at hand and thus make them capable to undertake any relevant task independently or as a team.
5. Motivate and create some awareness about the environment, to the industry in particular

**Topics Covered**
Unit 1 Characterization of liquid waste survey, sampling and material balance, segregation and equalization; Disposal of waste in environmental, effects on land receiving waters, standards.
Unit 2 Wastewater treatment, physical, chemical and biological processes Wastewater reclamation and reuse in industry.
Unit 3 Pollution abatement in major industries: Textile, paper and Pulp, Steel, Sugar, Distillery, Petroleum Refinery.
Unit 4 Sources and generation of gaseous pollutants, Effects on materials, health and plants, Air quality monitoring.
Unit 5 Air pollution control, methods for removal of particulates and gaseous pollutants, design principles.

**Text Books and/or Reference Materials**

**Additional Learning Source**
Civil Engineering  

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CE430</td>
<td>Structural Analysis-II</td>
<td>DE</td>
<td>CE 315</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop an understanding of theory and application of the various advanced methods of structural analysis.
2. To understand the analytical procedure related to the analysis of building frame by some classical methods viz. Kani’s methods and approximate methods of analysis.
3. To understand matrix method and its application for computer based analysis of structure.
4. To develop the skill to deals with the problems of moving loads in the structures and their analysis techniques.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concept of mathematics, statics and mechanics to understand the essentials of the advanced method of structural analysis.
2. Understand the structural actions viz. rotations and displacements, especially in building frames subjected to vertical and lateral loadings.
3. Generate mathematical expressions involving all possible structural actions.
4. Analyze building framing system and its components under the action of gravity and lateral loads and thereby developing database for the design of the structure.
5. Identify, formulate and solve engineering problems and to effectively use and apply the computer friendly structural analysis techniques viz. stiffness and flexibility methods to the field problems.
6. Deal with the problems of moving loads in the structures and their analysis techniques such as influence line diagram.
7. Use the techniques and modern engineering tools necessary for engineering practice.
8. Recognize the importance of good written communication skill and to know how to compile the analysis results so that it can be effectively used for the design of the structure.

**Topics Covered**

- **Unit 1** Analysis of building frames; Kani’s method and Approximate methods
- **Unit 2** Stiffness matrix method; Application to simple problems of beams and frames
- **Unit 3** Flexibility matrix method; Application to simple problems of beams and frames
- **Unit 4** Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams
- **Unit 5** Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller-Breslau principle, Influence lines for Arches and stiffening girders

**Text Books and/or Reference Materials**

1. Intermediate Structural Analysis by C. K. Wang
2. Basic Structural Analysis by C. S. Reddy.
3. Theory of Structures (Volume II) by B. C. Punmia

**Additional Learning Source**

Course Assessment Method

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

Course Objective

The main aim of this course is to provide the basic concepts of water power engineering such as power potential of streams, firm power and secondary power, intake structures, turbines, surge tanks, hydropower plants, water hammer analysis etc.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:
1. Gain knowledge regarding the various sources of energy available in nature and technology to harness them especially hydropower.
2. Generate basic database about river morphology, discharge, flow velocity, pondage, storage, minimum flow, river ecology and related environmental issues prior to planning and construction of hydroelectric scheme.
3. Learn about planning, designing of various types of hydroelectric schemes, their efficiency, plant, load and utilization factors.
4. Select location and function of various components of hydroelectric schemes such as intake, penstock, surge tank, draft tube, etc.
5. Distinguish the turbo-machines such as turbines, pumps and their selection based on type, speed and setting vis-à-vis problem of water hammer and cavitations phenomena.

Topics Covered

Unit 1: Introduction, sources of energy, water power development, power requirements, load studies, power available, power potential of stream, storage and pondage studies.
Unit 2: Hydro-power plants, classification, elements, Firm and secondary powers, load factor, utilization factor, plant factor.
Unit 3: Intakes, tunnel, penstocks and draft tubes, Water hammer analysis, surge tanks, classification, working principle.
Unit 4: Turbines, main features, performance, selection, capacity, salient features.

Text Books and/or Reference Materials

1. Dandekar and Sharma, “Hydro Power Engineering”
2. Varshney, “Hydro Power Structures” NCB, Roorkee, India.

Additional Learning Source

1. NPTEL course materials from different IITs.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE433</td>
<td>Advanced Highway Engineering</td>
<td>DE</td>
<td>CE 317</td>
<td>Theory</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The objective of this module is to understand the process of collecting information necessary for successful design of flexible and rigid pavements, including traffic data, material properties and other environmental factors.

1. Pavement design based on empirical and mechanistic relations between materials, geometry and performance.
3. Design of surface drainage system.
4. Construction and maintenance of roads.
5. Design of overlays, use of Benkelman beam deflection method for flexible overlays.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concepts of mathematics and hydraulics to the design of highway drainage.
2. Apply condition monitoring and maintenance of road pavements.
3. Conduct field testing for design of overlays especially in case of bituminous constructions.
4. Develop technical skills for maintenance of flexible and rigid pavements.
5. Understand the basic concepts of geometric design of highways by applying fundamental concepts of mathematics and laws of mechanics.
6. Recognize the importance of good written communication skills, and know how to write professional, clear, concise technical reports and letters to clients and colleagues.
7. Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes.

**Topics Covered**


Unit 2 **Hill Roads**: General considerations, Classification of hill roads, Alignment and geometrics of Hill roads. Design and construction of hill roads.

Unit 3 **Highway Drainage**: Importance, significance and requirement of highway drainage system. Surface and Sub-Surface Drainage, Construction of Roads in Water Logged Areas. Drainage of Slopes and Erosion Control.

Unit 4 **Highway Maintenance**: Causes and Types of Pavement Failure, Maintenance of Flexible and Rigid Pavements, Maintenance of WBM and bituminous surfaces, special repairs in flexible pavements. Strengthening of Existing Pavement. Objects, types and design of overlay. Benkelman beam deflection studies.

**Text Books and/or Reference Materials**


**Additional Learning Source**

1. Open courseware related to traffic and transportation engineering
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE434</td>
<td>Bridge Engineering</td>
<td>DE</td>
<td>CE 311, CE 395</td>
<td>Theory</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

The objective of this course is to introduce the theory and application of analysis and design of reinforced concrete and steel bridges. The course focuses on designing and understanding the structural behaviour of reinforced concrete and steel components of highway and railway bridges subjected to static and dynamic loads. The main objectives of the course are:

1. To introduce different types of highway and railway bridges.
2. To understand different types of loads standardized by Indian Road Congress (IRC) and Indian Railway Standard Code of Practice for Bridges.
3. To select a specific type of concrete/steel bridge to be constructed at a particular location.
4. To understand different methods of analyses and their application for designing deck slab of concrete bridges carrying wheel loads.
5. To design of slab culvert for IRC loading.
6. To understand different methods of load distribution among the longitudinal girders of a T-beam bridge.
7. To design of deck slab of a T-beam bridge for IRC loading.
8. To design of longitudinal girders of a T-beam bridge.
9. To design of cross girders of a T-beam bridge.
10. To design of piers and abutments of a T-beam bridge.
11. To analyse and design of balanced cantilever bridge.
12. To analyse and design of cable stayed bridge.
13. To design of plate girder bridge.
14. To design of truss Bridge.
15. To design of Suspension Cable Bridge.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Relate different design philosophies of the highway and railway bridges.
2. Understand the structural behaviour of different components of a reinforced concrete and steel bridge.
3. Analyze and design different components of a highway and railway bridge, to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability under loads standardised by Indian Road Congress (IRC) and Indian Railway Standard Code of Practice for Bridges respectively and submit the designs in complete and concise manner.
4. Use the techniques, skills, and modern engineering tools and softwares necessary for design and detailing.
5. Analyze and interpret the results using analytical tools and further plan, design and detail different bridges using relevant and upcoming BIS standards.
6. Interact and manage work with professionals of diverse background and talent.

**Topics Covered**

1. Classification of highway and Railway bridges
2. Site Selection for Bridges
3. Data of Geometric and Hydraulic Design
4. Loading Standards for Highway and Railway Bridges
5. General Design Considerations
6. Introduction to concrete bridges  
7. T-beam Bridge and its components  
8. Balanced Cantilever Bridge  
9. Cable Stayed Bridge  
10. Arch Bridge  
11. Introduction to steel bridges  
12. Plate Girder Bridge  
13. Truss Bridge  
14. Suspension Cable Bridge  
15. Design of Piers  
16. Design of Abutments  
17. Design of Pile and Well foundation  
18. Design of Bearings  
19. Seismic Design Considerations

**Text Books and/or Reference Materials**

1. Victor “Essentials of Bridge Engineering”, Oxford, New Delhi, India  
2. Arya & Ajmani “Design of Steel Structures”, Nem Chand, Roorkee, India  
4. Standard Specifications and Code of Practice for Road Bridges  
   b. Section II, Loads and Stresses, IRC:6-2000  
   c. Section III, Cement Concrete (Plain and Reinforced Concrete), IRC:21-2000  
   e. Section IX, Foundations and Substructure, IRC:78-2000  
   f. Section VII, Steel Road Bridges, IRC:24-2001  
5. Standard Specifications and Code of Practice for Railway Bridges  
   a. Indian railway Standard Code of Practice for the Design of Steel or Wrought Iron Bridges carrying Rail, Road or Pedestrian Traffic, Govt. Of India, Ministry of Railways, 1962  
7. I.S: 1893 2002- Indian Standard Code of Practice for Structural Safety of Structures, BIS, New Delhi, India  
8. S.P.:34- Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi, India

**Additional Learning Source**

1. NPTEL course materials from different IITs.  
2. Study through Journal Papers
Civil Engineering

Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
---|---|---|---|---|---|---|---|---
Civil Engineering | CE438 | Advanced Structural Analysis | DE | CE 430 | Theory | 4 | 3 | 1 | 0 | 4

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**
1. To develop an understanding of theory and application of the various advanced methods of stress analysis in engineering materials and structural elements.
2. To understand the analytical and experimental stress analysis techniques.
3. To understand finite element method and its application for computer based analysis of structure.
4. To equip students with finite element analysis fundamentals and formulate the design problems.
5. To develop the skill to apply the concept of finite element method to the common civil engineering structure.
6. To enable students to perform engineering simulation using FEM software ANSYS.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Apply fundamental concept of mathematics, statics and mechanics to understand the essentials of the advanced method of stress analysis.
2. Understand the structural actions viz. stress and strains, especially in various structural components under various types of loadings.
3. Generate mathematical expressions involving all possible structural actions and applying the same for various laboratory/field situations.
4. Identify and formulate mathematical models for solution of simple and common engineering problems into finite element.
5. Solve structural, impact, crash problems and fluid structure interaction problems.
6. Appreciate the importance of ethical issues pertaining to the effective utilization of FEA.

**Topics Covered**
This course is composed of four major components:

Unit 1
Elasticity: Introduction, Components of strain and strain, Hooke’s law, Plane stress and plane strain, Equations of equilibrium and compatibility, Boundary conditions, Two dimensional problems in rectangular and polar coordinates, Bending of simple and cantilever beams.

Unit 2
Model Analysis: Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations

Unit 3
Introduction to Finite element method for structural analysis; Review of principle of virtual work, Ritz method, Discretization of domain, Basic element shape, Discretization process

Unit 4
Application of finite element method to one and two-dimensional plane stress strain elements.

**Text Books and/or Reference Materials**

111
<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <a href="http://www.mece.ualberta.ca/tutorials/ansys/">www.mece.ualberta.ca/tutorials/ansys/</a></td>
</tr>
<tr>
<td>2. <a href="http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/">www.colorado.edu/engineering/cas/courses.d/IFEM.d/</a></td>
</tr>
</tbody>
</table>
Course Assessment Method

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

Course Objective

1. To develop an understanding of theory and application of the various advanced methods of bearing capacity analysis.
2. To understand the analytical procedure related to the analysis of foundation design in cohesive and non-cohesive soils by Hensen’s, Vesic’s bearing capacity theory, Terzaghi’s analysis and IRC-21 method.
3. To develop the skill to deals with the problems of single and multi-bulbs under reamed piles in expansive soils and their analysis techniques.
4. To enable students prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:
1. Apply fundamental concept of mathematics, statics and mechanics to understand the essentials of the methods of load carrying capacity of under-reamed piles and well foundations.
2. Generate mathematical expressions for design of various foundations and applying the same for different laboratory/field conditions.
3. Use the techniques and advanced engineering tools necessary for sinking of wells especially in case of bridges subjected to vertical and lateral loadings.
4. Identify, formulate and solve engineering problems and to effectively use and apply the computer skill for pile foundation analysis techniques such as cast in-situ, bored and pile load test methods to the field problems.
5. Design components of under-reamed and well foundations to meet desired needs within the manageable and realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability as per the codal provisions.
6. Estimate and apply soil-structure interaction, time-rate of foundation settlement concepts and identify appropriate deep foundation type for different soil profiles, types including expansive soils.
7. Evaluate pile capacity in the field using load tests, pile driving equations, and wave equation analysis to account for seismic loading.

Topics Covered

Unit 1 Foundation in Expansive Soil: Clay mineralogy, Basic structural units of Kaolinite, Illite and Montmorillonite clay minerals, Adsorbed water, Methods of foundation in expansive soils, Identification of expansive soils, Differential thermal analysis, X-ray diffraction and electron microscopy methods, Bearing capacity of single and multi bulb under-reamed pile foundation, IS: 2911 (Part III), Methods of installation of under-reamed piles, Bored, Cast in-situ and Compaction piles.

Unit 2 Shallow Foundation: Hensen’s and Vesic’s bearing capacity theory, IS Code method for bearing capacity, Standard penetration, Cone penetration and Plate load Tests, Effect of raising and lowering of water table on bearing capacity and settlement, Raft or Mat Foundations, Influence of inclined and eccentric loads.

Unit 3 Deep Foundation: Indian standard for pile load test, Bearing capacity of pile groups in cohesive and
cohesionless soils, Shear and settlement criteria for design of pile foundations, Bearing capacity of well foundations, Terzaghi’s analysis, Banerjee and Gangopadhyoy’s analysis, IRC-21 method.

Unit 4 Wave Propagation: Waves in elastic medium, Longitudinal, Shear and Rayleigh Waves, Elements of seismic methods, Direct arrival survey, Reflection survey and Refraction survey

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <a href="http://www.ce.washington.edu/~geotech/courses/cee523/manuals/">www.ce.washington.edu/~geotech/courses/cee523/manuals/</a></td>
</tr>
<tr>
<td>4. <a href="http://www.dfi.org/">www.dfi.org/</a></td>
</tr>
<tr>
<td>Department</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To gain knowledge on basic seismology like the causes of occurrence of earthquake and its characterization hazards and its consequences, earthquake measurement and instrumentation.
2. To develop an understanding of structural dynamics of simple systems subject to harmonic, impulse and/or arbitrary loading
3. To develop an understanding of construction of eigen value solution algorithms
4. To impart knowledge of analysis for lateral loads and codal provisions for earthquake resistant design of structures as per Indian Standards
5. To impart knowledge on different types of damages caused due to earthquake and retrofitting techniques

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Suggest possible causes for the movements of the plates and different types of plate boundaries.
2. Describe elastic rebound theory as it is related to seismic activity.
3. Distinguish between earthquake magnitude and earthquake damage (intensity).
4. Understand why earthquakes occur, how they are measured and categorized and the effect they may have on engineering structures.
5. Understand the concepts of seismic forces and how they relate to structures.
6. Develop an understanding of structural dynamics of simple systems subject to harmonic, impulse and/or arbitrary loading and predict its response.
7. Construct eigen value solution algorithms.
9. Apply the basic codal provisions for earthquake resistant design of structures as per Indian standards.
10. Understand the concepts retrofitting of structures.

**Topics Covered**

Unit 1 Seismology and Earthquake Inputs:
- Earth's interior and plate tectonics; causes of earthquakes and seismic waves
- Measurement of earthquakes and measurement parameters
- Predictive relationships for earthquake parameters
- Ground motion characteristics
- Concept of response spectrums of earthquake
- Combined D-V-A spectrum and construction of design spectrum
- Modification of earthquake due to the nature of soil
- Seismic hazard analysis

Unit 2 Dynamics for Earthquake Analysis:
- Equations of Motion for SDOF and MDOF Systems
- Undamped Free Vibration of SDOF and MDOF Systems
- Mode Shapes and Frequencies of MDOF System
- Rayleigh Damping Matrix
Modal Analysis in Time Domain

Unit 3  Design and retrofitting of buildings:
- Introduction, salient features of IS:1893 and IS:13920,
- IS earthquake design philosophy, permissible stresses and load factors,
- Determination of design lateral forces: Equivalent lateral force procedure and dynamic analysis procedure using IS and UBC codes.
- Definition of retrofitting, failure mode of buildings, types and methods for retrofitting of buildings.

Unit 4  Earthquake damages in buildings and its remedies as per IS codes:
- Introduction, salient features of IS:13935 and IS:4326;
- Identification of damage in RC buildings: soft storey failure, plan and mass irregularities, poor quality of construction material and corrosion of reinforcement, pounding of buildings; damages to structural and non-structural components; damage to water tank, parapets and staircase.
- Effect of structural irregularities on buildings: introduction; vertical irregularities: vertical discontinuities in load path, irregularities in strength and stiffness, mass irregularities, vertical geometric irregularities, proximity of adjacent buildings, plan configuration problems.
- Provision of different types of bands in masonry buildings. Salient features of IS:13920

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.  Dynamics of Structures - Application to Earthquake Engineering by A. K. Chopra</td>
</tr>
<tr>
<td>5.  David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London,</td>
</tr>
<tr>
<td>7.  Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI,</td>
</tr>
<tr>
<td>8.  I.S. Codes No. 1893, 4326, 13920 etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.  Web links related to Earthquake and Wind Engineering</td>
</tr>
</tbody>
</table>
Open Electives Courses

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>Total Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>CE444N</td>
<td>Disaster Management</td>
<td>OE</td>
<td>None</td>
<td>Theory</td>
<td>4</td>
<td>3 1 0</td>
<td>4</td>
</tr>
</tbody>
</table>

Course Assessment Method
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

Course Objective
1. To create awareness amongst students to basic issues of natural and manmade disasters.
2. To ensure the understanding of the disaster management cycle and relationship amongst vulnerability, preparedness, prevention and mitigation.
3. To invoke minimum ability and sensitivity amongst students to respond to disasters in their area of living and working.
4. To develop technical prowess and to mitigate the effects of disasters by capacity building amongst engineering fraternity towards formulation and implementation of disaster management strategies.
5. To relate amongst the basic approaches adopted in disaster risk reduction and institutional mechanism adopted in country towards creating resilient society.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understand genesis and causes of natural and manmade disaster within the framework of fundamental concepts of basic sciences and engineering.
2. Perceive the vulnerability of their living and working places and level of preparedness within the existing setup of disaster management.
3. Analyze and critically examine the vulnerability of a region and to employ adequate strategy and tools of intervention.
4. Build capacity to use specialized problem solving skills, methodologies and technology.
5. Setup priorities to develop coherent and adaptable disaster management plan.
6. Produce technical reports and database for effective communication amongst stakeholders to comprehend the problems of disaster management and to device improved technologies for future interventions.

Topics Covered
Unit 1 Natural and Man Made Disasters: Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Climatic change and extreme climate. Global warming, Sea level rise, ozone depletion. Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire. Pollution and environmental degradation. Road, rail, sea and air accidents.


Unit 4 Disaster Preparedness and Mitigation: Human behavior and response. International and National Strategies for disaster reduction. Concept of disaster management. National disaster management framework. Central, state, district and local administration; Armed forces, police, NDRF in disaster response, rescue and relief. Role of NGOs, community based organizations and media. Role of different engineering disciplines in preparedness, response, rescue, rehabilitation recovery, prevention and mitigation.

<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Additional Learning Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <a href="https://www.ndma.gov.in">https://www.ndma.gov.in</a></td>
</tr>
<tr>
<td>2. <a href="https://www.nidm.gov.in">https://www.nidm.gov.in</a></td>
</tr>
<tr>
<td>3. <a href="https://www.nicee.org">https://www.nicee.org</a></td>
</tr>
<tr>
<td>4. <a href="http://nptel.iitk.ac.in/">http://nptel.iitk.ac.in/</a></td>
</tr>
</tbody>
</table>
Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
---|---|---|---|---|---|---|---|---
Civil Engineering | CE481 | Fundamentals of Environmental Engineering | OE | None | Theory | 4 | 3 | 4

Course Assessment Method
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

Course Objective
1. To impart fundamental training and knowledge about this coveted field of engineering & sciences for students of other disciplines as well (like Electrical, Electronics, Mechanical, Petro-Chemical, Architecture etc.)
2. To develop basic understanding about the pollution control measures for water, air and land coupled with application in the industry of any nature.
3. To provide students an in-depth importance and understanding of the physical, chemical, and biological processes involved in the treatment of water, wastewater, air pollution control and disposal of solid wastes.
4. To develop a basic foundation for higher studies and research in both basic and applied environmental disciplines and provides a direct transition to the post-graduate engineering programs.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Differentiate between environmental sciences and engineering
2. Address the importance of the environment in general and may apply fundamental concepts of Environmental Engineering & Sciences in any field of their career.
3. Capable to face challenges and apply their knowledge in the areas of infrastructure development schemes, industry, and environmental remediation.
4. Hands-on basic design procedure, field studies, and trips provide an understanding of the problems at hand and thus make them capable to undertake any relevant task independently or as a team.
5. Motivate and create some awareness about the environment.

Topics Covered
Unit 1 Fundamentals of chemistry concept in environmental engineering: Water and Wastewater Quality Parameters, their units, laboratory techniques for measurement, significance and adverse impact on environment and human health
Unit 2 Fundamentals of microbiology in environmental engineering: Role of microorganisms in environmentally relevant processes including bioremediation of pollutants, biological treatment systems like activated sludge process, UASB etc.
Unit 4 Mass balance and energy balance approach: Material Balance, Types of Reactors, Reactor Kinetics, Steady-State Condition.
Unit 5 Environmental pollution and standards: Introduction to Air Pollution, their sources, standards, health effects, Introduction to Solid Waste Management and Noise Pollution and its control.

Text Books and/or Reference Materials
<table>
<thead>
<tr>
<th><strong>Additional Learning Source</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 3 Hour

**Course Objective**

1. To develop an appreciation of water as a vital commodity for survival of life system.
2. To develop an understanding of the maintenance of fresh water resources and optimal water use for sustainable development of the country.
3. To understand and experience physical, chemical and pathological properties of water and related health hazard mitigation.
4. To understand and apply project economics and cost benefit analysis, financial evaluation, project implementation, execution and management.
5. To understand rain water harvesting, river interlinking, water rights, water disputes and legislation.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concepts of water and land resources management to solve water shortage problems.
2. Understand the importance of optimal water use and to disseminate knowledge in society to keep water resources unpolluted and its judicious uses.
3. Implement collection and storage of water through rainwater harvesting for sustainable development in the perspective of increasing population and changing life styles of the society.
4. Solve the dual problems i.e. shortage of water in drought prone areas and safety of area against floods due to flood prone rivers.
5. Apply the knowledge in the management and development the water resources and to be able understand the importance of water quality and water born diseases to solve the health and environmental hazards problems.

**Topics Covered**

Unit 1  Types of watershed and their characteristics, Purpose of planning of watershed projects, Guidelines for project formulation, Management strategies, system concept, systems components.

Unit 2  Hydrologic cycle and its effect on man’s activity, surface and sub - surface runoff, erosion process, erosion control and sediment yield, sediment transport, Soil conservation practices.

Unit 3  Water resources and environmental problems, water quality management Design of water resources systems, Water management, rain water harvesting, river Interlinking, Water rights, Water disputes and legislation.

Unit 4  Flood and its mitigation, Environmental impact assessment, adverse effects of dams and reservoir on environment, watershed management with multiple use concepts.

Unit 5  Project economics: pattern of financing and credit, cost benefit analysis, Economic evaluation, project implementation and management, problems of execution and management.

**Text Books and/or Reference Materials**

2. Wurbs & James “Water resources Engineering”
5. K G Ranga Raju, “Flow through open channel”
6. K. Subramanya ”Engineering Hydrology.”

**Additional Learning Source**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Web links to e-learning: Nptel</td>
</tr>
<tr>
<td>2.</td>
<td>Web pages related to water resources engineering and management</td>
</tr>
</tbody>
</table>

*************************************************************END*************************************************************
## CURRICULUM FOR B. TECH. (CIVIL ENGG.)
### Effective for Students admitted in the Session 2011 – 2012 and Later

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Total number of contact hours</th>
<th>Credits</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lecture (L)</td>
<td>Tutorial (T)</td>
<td>Practical (P)</td>
</tr>
<tr>
<td>AM111</td>
<td>Mathematics-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>AM112</td>
<td>Mathematics-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>AP111</td>
<td>Applied Physics</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>AC111</td>
<td>Applied Chemistry</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>AP194</td>
<td>Applied Physics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>AC194</td>
<td>Applied Chemistry Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>EN101</td>
<td>English</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>EE111</td>
<td>Basic Electrical &amp; Electronics Engg.</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ME101</td>
<td>Basic Thermal Sciences</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ME111</td>
<td>Applied Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ME193</td>
<td>Engg. Graphics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>ME194</td>
<td>Manufacturing Process Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO191</td>
<td>Computer Programming Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CE111</td>
<td>Environmental Studies</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27</td>
<td>14</td>
<td>10</td>
</tr>
</tbody>
</table>

### THIRD SEMESTER (AUTUMN SEMESTER) 2 YEAR

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Total number of contact hours</th>
<th>Credits</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lecture (L)</td>
<td>Tutorial (T)</td>
<td>Practical (P)</td>
</tr>
<tr>
<td>AM211</td>
<td>Mathematics-III</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE212</td>
<td>Civil Engg. Materials</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE213</td>
<td>Fluid Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE215</td>
<td>Engg. Geology</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE220</td>
<td>Quantity Survey</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE291R</td>
<td>Civil Engg. Materials Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CE292R</td>
<td>Fluid Mechanics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CE293R</td>
<td>Engg. Geology Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

### FOURTH SEMESTER (WINTER SEMESTER) 2 YEAR

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Total number of contact hours</th>
<th>Credits</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lecture (L)</td>
<td>Tutorial (T)</td>
<td>Practical (P)</td>
</tr>
<tr>
<td>AM212</td>
<td>Mathematics-IV</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE216</td>
<td>Structural Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE217</td>
<td>Construction Practice</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE218R</td>
<td>Surveying</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE219</td>
<td>Hydrology</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CE286R</td>
<td>Engg. Geology Camp</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Code</td>
<td>Course Description</td>
<td>Credits</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------</td>
<td>---------</td>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>EZ291</td>
<td>Communication Skills Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CE294R</td>
<td>Structural Mechanics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CE295R</td>
<td>Surveying Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**FIFTH SEMESTER (AUTUMN SEMESTER) 3 YEAR**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
<th>Credits</th>
<th>Theory</th>
<th>Practical</th>
<th>Lab</th>
<th>Total</th>
<th>15</th>
<th>8</th>
<th>6</th>
<th>29</th>
<th>27</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE311</td>
<td>Design of Concrete Structures-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE312</td>
<td>Soil Mechanics</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE313N</td>
<td>Environmental Engg.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE384R</td>
<td>Survey Camp</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0*</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE391R</td>
<td>Soil Mechanics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE392R</td>
<td>Environmental Engg. Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DE-I</td>
<td>Departmental Elective-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>DE-II</td>
<td>Departmental Elective-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**SIXTH SEMESTER (WINTER SEMESTER) 3 YEAR**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
<th>Credits</th>
<th>Theory</th>
<th>Practical</th>
<th>Lab</th>
<th>Total</th>
<th>15</th>
<th>8</th>
<th>6</th>
<th>26</th>
<th>26</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE315</td>
<td>Structural Analysis-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE316</td>
<td>Engg. Hydraulics-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE317</td>
<td>Transportation Engg.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE318N</td>
<td>Design of Steel Structures</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE389</td>
<td>Colloquium</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE395R</td>
<td>Steel Design Practice Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE396R</td>
<td>Hydraulics Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE397R</td>
<td>Transportation Engg. Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SEVENTH SEMESTER (AUTUMN SEMESTER) 4 YEAR**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
<th>Credits</th>
<th>Theory</th>
<th>Practical</th>
<th>Lab</th>
<th>Total</th>
<th>15</th>
<th>8</th>
<th>6</th>
<th>28</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE411</td>
<td>Design of Concrete Structures-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE413</td>
<td>Foundation Engg.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE488R</td>
<td>Professional Training</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0*</td>
<td>1.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE491R</td>
<td>Concrete Design Practice Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE492R</td>
<td>Structural Lab</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE494A</td>
<td>Project A</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>4.0</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DE-III</td>
<td>Departmental Elective-III</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>OE-I</td>
<td>Open Elective-I</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**EIGHTH SEMESTER (AUTUMN SEMESTER) 4 YEAR**

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
<th>Credits</th>
<th>Theory</th>
<th>Practical</th>
<th>Lab</th>
<th>Total</th>
<th>15</th>
<th>8</th>
<th>6</th>
<th>25</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE410</td>
<td>Construction Management</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE414</td>
<td>Engg. Hydraulics-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE415</td>
<td>Irrigation Engg.</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>CE493N</td>
<td>Design of Irrigation works</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2.0</td>
<td>60</td>
<td>40</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Seminars, project works may be considered as practical.

*Courses based on field training involving one day to a month.

**List of Departmental Elective Courses**

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credits</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>CW</th>
<th>ME</th>
<th>EE</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>CE421</td>
<td>Concrete Technology</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE425</td>
<td>Advanced Hydrology</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE427</td>
<td>Geo-Engineering of Rocks and Rock Mass</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE428</td>
<td>Dam Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE429</td>
<td>Industrial Pollution Control</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE430</td>
<td>Structural Analysis-II</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE432</td>
<td>Water Power Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE433</td>
<td>Advanced Highway Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE434</td>
<td>Bridge Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE438</td>
<td>Advanced Structural Analysis</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE441</td>
<td>Advanced Foundation Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>DE</td>
<td>CE445N</td>
<td>Elements of Earthquake &amp; Wind Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

**List of Open Elective Courses**

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credits</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>CW</th>
<th>ME</th>
<th>EE</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>OE</td>
<td>CE444N</td>
<td>Disaster Management</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>OE</td>
<td>CE481</td>
<td>Fundamentals of Environmental Engineering</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>OE</td>
<td>CE483</td>
<td>Water Resources &amp; Watershed Management</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

**Nomenclature:**

- BS : Basic Science
- ESA : Engineering Science & Arts
- HM : Humanities
- DC : Departmental Core (Essential)
- DE : Department Elective
- OE : Open Elective

**Degree Requirements**

<table>
<thead>
<tr>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>28</td>
</tr>
<tr>
<td>ESA</td>
<td>29</td>
</tr>
<tr>
<td>HM</td>
<td>10</td>
</tr>
<tr>
<td>DC</td>
<td>109</td>
</tr>
<tr>
<td>DE</td>
<td>16</td>
</tr>
<tr>
<td>OE</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200</strong></td>
</tr>
</tbody>
</table>