**Ministry of Higher Education and Scientific Research**
**University of Technology**
**Building and Construction Engineering Department**
**Undergraduate Study Syllabus 2016/2017**
**Third Year**

# 1- Building eng. And Project Management

First Semester

| Subject | | Hrs./week | | | Units |
|---|---|---|---|---|---|
| | | Theo. | Tut. | Lab. | |
| B.E 3228 | Soil Mechanics (1) | 2 | 2 | 1 | 3 |
| B.E 3238 | Building Services (1) | 2 | | | 2 |
| B.E 3231 | Engineering Analysis | 2 | 2 | | 2 |
| B.E 3233 | Theory of Structures (1) | 2 | 2 | | 2 |
| B.E 3235 | Principles of Remote Sensing (1) | 1 | 1 | 1 | 2 |
| B.E 3239 | Sanitary and Environmental Eng. (1) | 1 | 1 | 1 | 2 |
| B.E 3302 | Civil Eng. System Analysis (1) | 2 | | | 2 |
| B.E 3234 | Reinforced Concrete Design (1) | 2 | 1 | | 2 |
| B.E 3109 | English A say Writing Language | 1 | | 1 | 2 |
| B.E 3111 | Leadership and Management Skills | 1 | 1 | | 1 |
| **Total** | | **16** | **10** | **4** | **20** |
| | | **30-** | | | |

Second Semester

| Subject | | Hrs./week | | | Units |
|---|---|---|---|---|---|
| | | Theo. | Tut. | Lab. | |
| B.E 3229 | Soil Mechanics (2) | 2 | 2 | 1 | 3 |
| B.E 3232 | Numerical Analysis | 1 | 1 | 1 | 2 |
| B.E 3304 | Quality Control of Building Materials | 2 | | | 2 |
| B.E 3236 | Principles of Remote Sensing (2) | 1 | 1 | 1 | 2 |
| B.E 3237 | Reinforced Concrete Design (2) | 2 | 1 | | 2 |
| B.E 3230 | Highway Engineering | 2 | 1 | 2 | 3 |
| B.E 3240 | Sanitary and Environmental Eng. (2) | 1 | 1 | 1 | 2 |
| B.E 3303 | Civil Eng. System Analysis (2) | 2 | | | 2 |
| B.E 3305 | Quality Control of Concrete | 1 | 1 | | 1 |
| B.E 3306 | Sustainable Building Material | 1 | 1 | | 1 |
| **Total** | | **15** | **9** | **6** | **20** |
| | | **30** | | | |

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| B.E. : 3228 Soil Mechanics (1) | Theory: 2hrs/week<br>Tutorial: 2hrs. / week<br>Practical: 1 hr./week |
|---|---|
| 1- Geotechnical Properties<br>Formation of soil, Grain size distribution , Clay minerals | 4 |
| 2- Soil classification | 4 |
| 3- Weight-Volume relationship | 8 |
| 4- Soil Compaction | 4 |
| 5- Hydraulic Properties<br>Field and Lab. Permeability | 4 |
| 6- Steady state Flow:<br>One and Two-dimensional flow, flow net, piping and boiling. | 16 |
| 7- Principle of effective stress<br>Total stress, effective stress,<br>pore water pressure. | 12 |
| 8- Stresses within a Soil Mass, geostatic stresses, Stresses due to external loads. | 8 |
| total | 60 |
| Lab. 1 hr./week | |
| 1.Water content | 1 |
| 2. Atterberg limits | 2 |
| 3. Specific gravity | 2 |
| 4. Sieve analysis | 1 |
| 5. Hydrometer analysis | 3 |
| 6. Compaction test | 2 |
| 7. Field density test | 2 |
| 8.Permeability test | 2 |
| total | 15 |

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| B.E 3238 | Building Services (2 Hrs. / week) | Hrs. |
|---|---|---|
| Introduction | | 2 |
| Type of pipes and Fitting used in water system<br>1. Type of pipes.<br>2. Type of Valves.<br>3. Pipe supports. | | 2 |
| Design and Analysis of Cold Water System. | | 6 |
| Design and Analysis of Hot Water System. | | 4 |
| Calculation of Hot water storage Capacity and Heater Power. | | 4 |
| Design of Sanitary System. | | 6 |
| Design of Storm Water Drainage System. | | 2 |
| Design of Fire Protection System. | | 4 |
| Total | | 30 |

| B.E 3302 Civil Eng. System Analysis (1) | (2 Hrs/week) |
|---|---|
| Introduction civil engineering system | 4 |
| Mathematical model in linear programming | 8 |
| Graphical method in LP | 4 |
| Simplex method | 4 |
| Two phase method in LP | 4 |
| Dual problems | 2 |
| Assignment strategy<br>- Hungarian method | 4 |
| total | 30 |

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| B.E. 3231: Engineering Analysis | Theory: 2hrs./ Week<br>Tutorial: 1hr./ Week |
|---|---|
| 1- Ordinary differential equations-:<br>1-1 Applications of first order differential equations.<br>1-1-1 Salt concentration in tanks.<br>1-1-2 Discharge through orifices.<br>1-2 Applications of second and higher order differential equations.<br>1-2-1 Mechanical vibration.<br>1-2-2 Elastic stability.<br>1-2-3 Newton's 2nd law of motion. | 12 |
| 2- Simultaneous linear differential equations.<br>2-1 Cramer's rule.<br>2-2 Applications.<br>2-2-1 Salt concentration in tanks.<br>2-2-2 Mechanical vibration- stiffness formulation.<br>2-2-3 Frequency of structures by the energy conservation law. | 12 |
| 3- Second & higher order linear differential equations with no constant coefficients.<br>3-1 Euler method.<br>3-2 Power series (Frobenius method). | 12 |
| 4- Fourier series:<br>4-1 Periodic functions & Fourier coefficients.<br>4-2 Even & odd functions.<br>4-3 Half range expansion. | 12 |
| 5- Partial differential equations:<br>5-1 Separation of variables method.<br>5-2 Applications. | 12 |

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| B.E. 3109: English Essay Writing Language | Theory: 2 hrs./ Week |
|---|---|
| Unit One: Introduction to Scientific Statements<br>1.1 Be and have in scientific statements<br>1.2 Statements requiring the present simple | 6 |
| Unit Two: Dimensions and Properties<br>2.1 Dimensions<br>2.2 Properties<br>2.3 Negative form of the simple present statement<br>2.4 'Fronted' statements (structure 3) | 6 |
| Unit Three: Comparatives Data<br>3.1 Simple statements of comparison<br>3.2 The superlative degree | 6 |
| Unit Four: Impersonal Scientific Statements-The Passive<br>4.1 Use of the passive<br>4.2 Form of the passive<br>4.3 Spelling rules<br>4.4 Suffixes | 4 |
| Unit Five: Experimental Descriptions | 4 |
| Unit six: Describe Charts and Graphs<br>6.1 The criteria of the academic writing<br>6.2 Describing Figures (Bar Charts)<br>6.3 Describing the graphs | 4 |

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| B.E. 3111 : Leadership & Management Skills | 2 Hrs./Week |
|---|---|
| Management framework | 4 |
| Management the Life Cycle | 3 |
| Basic Planning Principles | 4 |
| Risk Management | 3 |
| Ethics and Transparency in Public Organization | 3 |
| Motivating of Team | 3 |
| Assuring Project Quality | 4 |
| Data Collection and Analysis | 3 |
| Project Control Frame Work | 3 |
| TOTAL | 30 |

| B.E.3235 : Principle of Remote sensing (1) | Theory: 1hr/ Week<br>Tutorial: 1hr./ Week<br>Lab :1hr/ Week |
|---|---|
| 1. Basic concepts, Definitions, importance and advantages, Comparison to maps, GIS, aerial photography and sonar. | 2 |
| 2. Components, Data representation, Applications (Agriculture and forestry, geology, hydrology, land-use and land-cover, mapping, meteorology, environment) | 2 |
| 3. Electromagnetic (EM) radiation, EM energy, Interaction mechanisms (Reflectance, Emissivity), Laws regarding amount of energy radiated from an object, Parts of EM spectrum. | 2 |
| 4. EM Spectrum, Wavelength bands, atmosphere effects and interaction between E.M rays and atmosphere, scattering, absorption, reflectance spectra | 2 |
| 5. Sensors, History, Satellite characteristics, Orbits and swath width, Scanner sensor systems. | 2 |
| 6. Spatial, spectral, radiometric and temporal resolutions, overview of different sensors, satellite and airborne comparison | 2 |
| 7. Properties of aerial photography, components of aerial cameras, Image motion, classification of aerial photos, orientation of camera axis, angular coverage, emulsion type. | 2 |
| 8. Geometric properties of aerial photo, definitions, image and object space, photo scale, and relief displacement. | 2 |
| 9. Relationship between coordinates of image and objects points, ground coordinates from vertical photo, photo overlap | 2 |
| 10. Applications and examples of aerial photo, distance between flight lines, No. of images, area of image and one model. applications & examples for flight lines design | 2 |
| 11. Digital Image processing: Image enhancement: Image reduction and magnification, contrast enhancement. | 2 |
| 12. Band ratio, spatial filtering, digital image classification | 2 |
| 13. Images corrections: Radiometric and geometric corrections, images rectification. | 3 |

| | |
|---|---|
| 14. Ground control points, No. of GCCs, root mean square error RMSE, resampling methods. | 3 |
| Total | 30 |
| | |
| Lab. 1hrs/week | |
| 1. Photogrammetry Exercise: scale, length and area. Air photo interpretation exercise (groups); Aerial photography for land cover mapping. | 1 |
| 2. Photogrammetry Exercise: radial/relief displacement. | 1 |
| 3. Photogrammetry Exercise: stereo pairs. | 1 |
| 4. Measurement and Analysis of Reflectance. Reflectance Spectra | 1 |
| 5. Identifying Digital image, Methods of image processing | 1 |
| 6. Identifying ERDAS software | 1 |
| 7. Viewer& Band combination. Image Export and Import | 1 |
| 8. Subsets | 1 |
| 9. Georeferencing using a georeferenced image Georeferencing using coordinates from a GPS unit. | 1 |
| 10. Image Enhancement and filters | 1 |
| 11. Image Merging (Pansharpening) | 1 |
| 12. Mosaic Images | 1 |
| 13. Unsupervised Classification and Supervised Classification | 1 |
| 14. Classification Accuracy | 2 |
| Total | 15 |

| B.E. 3234 : Reinforced Concrete Design (1) | Theory: 2hrs./ Week<br>Tutorial: 1hr./ Week |
|---|---|
| 1. Introduction to reinforced concrete ( concrete and steel) | 6 |
| 2. Introduction to methods of design and analysis for concrete structures and load stages for beam with equivalent cracks section for singly, doubly and T-sections | 6 |
| 3. Analysis and design of singly reinforced concrete beams by ultimate strength design method | 6 |
| 4. Analysis and design of doubly reinforced concrete beams by ultimate strength design method | 6 |
| 5. Analysis and design of T and L reinforced concrete beams by ultimate strength design method | 6 |
| 6. Design of continuous beams and one way slabs using coefficient methods | 15 |
| Total | 45 |

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| B.E. 3239: Sanitary and Environmental engineering (1) | Theory: 1hr./ Week<br>Tutorial: 1hr./ Week |
|---|---|
| 1. Introduction to sanitary engineering<br>1.1 sources of water | 2 |
| 1.2 Population estimation methods | |
| 1.3 fire demand calculation | |
| 2. Water Quality Characteristics | 4 |
| 3. Water Treatment Plant Unites<br>3.1 Intake | 2 |
| 3.2 Screen | 2 |
| 3.3 Sedimentation: coagulation and flocculation processes | 4 |
| 3.4 Overflow rate and design | 4 |
| 3.5 Filtration | 4 |
| 3.6 Disinfection | 2 |
| 3.7 Pumps types and applications | 2 |
| 4. Network and water distribution | 4 |
| Lab. | 1hr./ Week |
| 1.Physical Properties | 1 |
| 2.Determination of pH value | 1 |
| 3.Conductivity | 1 |
| 4.Turbidity | 1 |
| 5.Jar $Test_1$ | 2 |
| 6.Jar $Test_2$ | 2 |
| 7.Setting Column | 2 |
| 8.Free Chlorine & Combined Chlorine | 2 |
| 9.Filtration Capacity | 2 |
| 10.Oil & Grease | 1 |

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| B.E. 3233: Theory of Structures (1) | Theory: 2hrs./ Week<br>Tutorial: 2hr./ Week |
|---|---|
| 1. Determinate Structures<br>1.1 Introduction + Stability and determinacy | 6 |
| 1.2 Influence Lines - Beams | 4 |
| 1.3. Influence Lines - Girder | 6 |
| 1.4. Influence Lines – Frame, Truss and Composite | 4 |
| 2. Deformation of Structures<br>2.1. Deflection and Rotation | 16 |
| 3. Indeterminate Structures<br>3.1. Introduction to indeterminate structures. Consistent deformation for the analysis of indeterminate frames and Trusses. | 4 |
| 3.2. Symmetry and Anti-Symmetry | 2 |
| 3.3. Slope deflection Method | 18 |
| Total | 60 |

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| **B.E 3303 Civil Eng. System Analysis** | (2 Hrs/week) |
|---|---|
| Transportation method<br>- Least cost<br>- Vogel<br>- optimum solution | 8 |
| Decision Making,<br>- element of decision problem<br>- decision model<br>- decision trees | 10 |
| Fundamental of probability,<br>decision based on expected value | 6 |
| Simulation concepts<br>- simulation model application in simulation problem<br>- monte-carlo simulation | 3 |
| Total | 30 |

| ***B.E 3304: Quality Control of Building Materials*** | **Theory: 2 hrs./ Week** |
|---|---|
| 1. Introduction and definition of quality. | 6 |
| 2. Importance and types of quality control systems: ISO 9001 Quality control system | 4 |
| 3. Quality control techniques: introduction; the nature of variability; quality assurance; control charts. | 4 |
| 4. Calculation and drawing of Shewhart control charts. | 4 |
| 5. Calculation and drawing of Cusum control charts. | 4 |
| 6. Sampling, inspection and testing of building materials | 4 |
| 7. Iraqi codes and International Specifications and standards | 4 |

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| ***B.E 3305: Quality Control of Concrete*** | **Theory: 2 hrs./ Week** |
|---|---|
| 1. Introduction to Quality Control requirements for concrete. | 6 |
| 2. Fresh concrete: QC requirements for placing and compaction; curing. | 4 |
| 3. Quality Control requirements for concreting in cold and hot weathers. | 4 |
| 4. Quality Control requirements for transport of concrete; formwork. | 4 |
| 5. Quality Control requirements for Handling Erection of precast concrete elements. | 4 |
| 6. Quality Control requirements for cement, aggregate and other materials. | 4 |
| 7. Comparisons between Iraqi codes and international standards: Some applications | 4 |

| ***B.E 3306 Sustainable Building Materials*** | Theory: 2 hrs./ Week |
|---|---|
| 1. Introduction and definition of sustainability. | 6 |
| 2. Carbon footprint, thermal transmission and thermal mass. | 4 |
| 3. Longevity and service life. | 4 |
| 4. Storm water management and sustainability. | 4 |
| 5. Human factor and living/ working environments. | 4 |
| 6. Safety and security. Economic impact. | 4 |
| 7. Resilience with climate change. Applications. | 4 |

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| B.E. 3230 : Highway Engineering | Theory: 2hrs./ Week Tutorial: 1hr./ Week<br>Lab. : 2 hr./Week |
|---|---|
| 1- Transportation planning | 3 |
| 2- Selection of route location of highways | 3 |
| 3- Surveys and costs | 6 |
| 4- Cross section characteristics highways | 3 |
| 5- Design of horizontal alignment | 6 |
| 6- Design of vertical alignment | 6 |
| 7- Asphalt concrete mix design | 6 |
| 8- Flexible pavement design | 3 |
| 9- Rigid pavement design | 3 |
| 10- Traffic engineering | 3 |
| 11- Pavement drainage | 3 |
| Lab. : 2hr./Week | |
| 1- Penetration test | 2 |
| 2- Ductility test | 4 |
| 3- Softening point test | 4 |
| 4- Flash point test | 4 |
| 5- Viscosity test | 4 |
| 6- Loss on heating test | 4 |
| 7- C.B.R. test | 4 |
| 8- Marshall test | 4 |

| B.E. 3232: Numerical Analysis | Theory: 1hr./ Week<br>Tutorial: 1hr./ Week<br>Lab. : 1hr./Week |
|---|---|
| 6- Matrices:<br>6-1 Review.<br>6-2 Solution of linear ordinary differential equations.<br>6-2-1 Row of transformation (matrix inversion).<br>6-2-2 Gauss elimination.<br>6-2-3 Gauss-Jordan method.<br>6-2-4 Gauss-Seidel method.<br>6-2-5 L-U method.<br>6-2-6 Eigen values & Eigen vectors. | 4 |
| 1- Introduction to numerical methods:<br>7-1 Difference table.<br>7-2 Differences & divided differences. | 4 |
| 2- Linear interpolation:<br>8-1 Newton-Gregory interpolation polynomial.<br>8-2 Newton-Divided difference formula.<br>8-3 Lagrange interpolating polynomial. | 4 |
| 3- Numerical integration: | 4 |

| | |
|---|---|
| 9-1 Trapezoidal and Simpson's rules.<br>9-2 Gaussian quadrature. | |
| 4- Solution of non-linear equations:<br>10-1 Newton-Raphson method.<br>10-2 Indeterminate coefficients.<br>10-3 Indeterminate weights. | 4 |
| 5- Numerical solution of ordinary differential equations (initial value problems):<br>11-1 Taylor series.<br>11-2 Euler method.<br>11-3 Modified Euler method.<br>11-4 Runge-Kutta $4^{th}$ order method. | 4 |
| 6- Finite difference methods for boundary-value problems. | 6 |
| Lab. : 1hr./Week | |
| 1- Interpolation | 2 |
| 2- Integration | 2 |
| 3- Solution of non-linear equations | 2 |
| 4-Systems of simultaneous Equations | 2 |
| 5- Numerical solution of ordinary differential equations (initial value problems) | 2 |
| 6- Finite difference method. | 3 |
| 7- Examination. | 2 |

| B.E.3236 : Principle of Remote sensing (2) | Theory: 1hr/ Week<br>Tutorial: 1hr./ Week<br>Lab :1hr/ Week |
|---|---|
| 1. Elements of Geographical Information Systems (GIS): Introduction, format of the Geographical data. | 2 |
| 2. GIS components and structure, spatial data models vector format, raster or grid model | 2 |
| 3. Thermal Infrared Images, principles, kinetic heat, radiant flux and temperature, thermal radiation law, diurnal temperature cycle, emissivity, thermal sensing system | 2 |
| 4. Factors effecting separation of target from background, advantages and disadvantages of thermal Imaging system, factors affecting thermal imagery, thermal sensing systems [detection/recognition and range of a FLIR Sensor] | 2 |
| 5. Active remote sensing (Radar images), microwave, terrestrial surface object parameters (roughness, electrical properties). | 2 |
| 6. Radar system parameters (signal wavelength and polarization, inclination angle, spatial resolution), advantages of radar data, radar sensor types. | 2 |
| 7. Mathematical applications and examples on thermal and radar imaging. | 2 |
| 8. Active remote sensing (Radar images), Laser scanning, basic principles, Laser-Radar performance (Laser- Radar equation, receivers). | 2 |
| 9. Basic principles of laser ranging, profiling and scanning, flight planning | 2 |
| 10. Examples and Applications | 2 |
| 11. Principle of digital terrain modeling | 2 |
| 12. Digital terrain surface modeling<br>Interpolation Techniques for terrain surface modeling | 2 |
| 13. GPS: principles and basics. Types of systems, measurements steps, GPS | 3 |

| | |
|---|---|
| observables. | |
| 14. GPS positioning modes, GPS methods GPS applications and accuracy. | 3 |
| Total | 30 |
| | |
| Lab. 1hrs/week | |
| 1. Map (Categories, types, scale, symbol, Map projection (UTM), shape of the earth and coordinates systems. | 1 |
| 2. GIS: definition, Components, uses of GIS, GIS data model and Functions. | 1 |
| 3. Fundamentals of Arc Map, General view on Arc Map, Arc Toolbox, Catalog, Arc GIS, and Management of contents table (TOC). | 1 |
| 4. Built the personal Geodatabase, Create shape file, Open existing shape file. | 1 |
| 5. Drawing, snap and editing feature. | 1 |
| 6. Symbolizing, Topology and Editing | 1 |
| 7. Geometric correction | 1 |
| 8. Create point's layer from coordinates (X, Y, Z). | 1 |
| 9. Arc toolbox (buffer , clip , intersect) | 1 |
| 10. Labels, Graphs and reports | 1 |
| 11. Start project with Arc Map, Map production (Layout) | 1 |
| 12. Introduction to GPS Geo-Xt Trimble. | 1 |
| 13. GPS Applications (1) | 1 |
| 14. GPS Applications (2) | 2 |
| Total | 15 |

| B.E. 3237 : Reinforced Concrete Design (2) | Theory: 2hrs./ Week<br>Tutorial: 1hr./ Week |
|---|---|
| 1. Deflection of beams (singly, doubly , T beams and continuous beams) and one way slabs | 12 |
| 2. Shear and diagonal tension design for beams | 6 |
| 3. Torsion design of beams | 9 |
| 4. Design of two way slabs by using coefficient method 2 or 3 | 12 |
| 5. Introduction to concentrically loaded columns. | 6 |
| Total | 45 |

| B.E. 3240: Sanitary and Environmental engineering (2) | Theory: 1hr./ Week<br>Tutorial: 1hr./ Week |
|---|---|
| 1. Sewer materials | 2 |
| 2. Characteristics of wastewater<br>2.1 Physical, chemical and microbiological Characteristics | 4 |

| | |
|---|---|
| 2.2 Sewage disposal | 4 |
| 3. Wastewater Treatment Plant Unites | 2 |
| 3.1 Preliminary treatment systems | 2 |
| 3.2 Primary treatment | 4 |
| 3.3 Biological treatment | 4 |
| 3.4 Secondary Treatment Systems | 4 |
| 4. Sludge Treatment and Disposal | 2 |
| 5. Miscellaneous Wastewater Treatment Techniques | 2 |
| Lab. | 1hr./ Week |
| 1.Salinity | 1 |
| 2.Solid Measurement:<br>a-Total solids | 1 |
| b-Total Dissolved solids | 1 |
| c-Total suspended solids | 1 |
| 3.Alkalinity | 1 |
| 4.Total Hardness | 1 |
| 5.Calcium Hardness | 1 |
| 6.Chlorides | 1 |
| 7.Dissolved Oxygen | 2 |
| 8.Biochemical Oxygen Demand (BOD) | 1 |
| 9.Chemical Oxygen Demand (COD) | 1 |
| 10.Iron | 1 |
| 11.Lead | 1 |
| 12.Cadmium | 1 |

| B.E. 3229 : Soil Mechanics (2) | Theory: 2hrs/week<br>Tutorial: 2hrs. / week<br>Practical: 1 hr./week |
|---|---|
| 1. Consolidation theory and settlement: Terzagi theory and assumptions, Consolidation test | 8 |
| 2. Consolidation analysis. Consolidation Settlement and Degree of Consolidation. | 16 |
| 3. Shear Strength of Soils : Mohr-Coulomb theory | 8 |
| 4. Laboratory test, direct shear, triaxial test and coefficient of pore water pressure. | 12 |

| | |
|---|---|
| 5. Slop Stability , stability calculation for granular and cohesive soils | 8 |
| 6. Total stress analysis for determination of Factor of safety , Taylor's Stability number | 4 |
| 7. Effective stress analysis for determination of factor of safety<br>a- The conventional method.<br>b- The Simplified method.<br>c- The Rigorous method. | 4 |
| Total | 60 |
| Lab. 1 hr./week | |
| 1. Consolidation test | 3 |
| 2. Unconfined compression test | 3 |
| 3. Direct shear test | 3 |
| 4. Triaxial compression test | 3 |
| 5. California Bearing Ratio test | 3 |
| Total | 15 |