UNIVERSIDAD AUTÓNOMA DE BAJA CALIFORNIA

COORDINACIÓN GENERAL DE FORMACIÓN BÁSICA
COORDINACIÓN GENERAL DE FORMACIÓN PROFESIONAL Y VINCULACIÓN UNIVERSITARIA
PROGRAMA DE UNIDAD DE APRENDIZAJE

I. IDENTIFICATION INFORMATION

1. **Academy unit:** Facultad de Ingeniería, Mexicali; Facultad de Ingeniería, Arquitectura y Diseño, Ensenada; y Facultad de Ciencias de la Ingeniería y Tecnología, Valle de las Palmas.

2. **Study program:** Bachelor, Civil Engineer

3. **Plan duration:** 2020-1

4. **Name of the learning unit:** Design of Reinforced Concrete and Masonry Structures

5. **Code:** 36032

6. **HC:** 01 **HL:** 00 **HT:** 03 **HPC:** 00 **HCL:** 00 **HE:** 01 **CR:** 05

7. **Learning stage to which it belongs:** Disciplinary

8. **Character of learning unit:** Obligatory

9. **Requirements for enrollment to learning unit:** None

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II. GENERAL PROPOSE OF THE COURSE

This class gives the student the knowledge for application of check and design criteria for reinforced concrete and masonry elements, giving him also the bases to design residential, industrial and commercial buildings; that constitute basic infrastructure in a society, following applicable standards and using local, national and international codes.

The class is located in the disciplinary stage and it is mandatory and a part of the knowledge area of Materials and Structural Design.

III. COURSE COMPETENCIES

To apply the local, national and international design codes through the plastic design theory, to design reinforced concrete and masonry elements in an ambient of responsibility and respect.

IV. EVIDENCES OF PERFORMANCE

Elaborate and turn in an application project where the student can apply the knowledge to design reinforced concrete and masonry elements integrating all the calculus that are part of the solution for the structural system in a building.

V. DEVELOPMENT BY UNITS

UNIT I. Flexural Design

Competence:
Identify the theorical-practical fundamentals that allow recognize the flexural effects on the reinforced concrete elements, through the representation of design loads, stresses, unit deformation of Steel in tension and resistance, to select the design codes criteria applicable, all of this with an analytic, critic and responsible attitude.

Content : **Duration:** 2 hours

1.1 Security dispositions of the ACI code and the NTC of RC
1.2 Plastic design of structures.
1.3 Plastic design hypothesis.
1.4 Resistance reduction factors.
1.5 Design resistance.
1.6 Historical development of flexural design.
1.7 Fundamental principles in the flexural design.
1.8 Whitney method
1.9 Analysis and design of beams for flexure.

UNIT II. Flexural Elements

Competence:
To apply the criteria for structural design, considering local and international codes in the design of elements subjected to flexural loads, to give the necessary analysis in a civil engineering project, with an analytic, critic and proposal attitude.

Content : **Duration:** 4 hours

2.1 Analysis and design of under-reinforced beams.
2.2 Analysis and design of beams with compression reinforcement.
2.3 Analysis and design of T beams.
2.4 Analysis and design of a one-wal shell.
2.5. Analysis and design of shells supported by perimeter.
- 2.5.1 Type of shells classification
- 2.5.2 Solid shells
- 2.5.3 Light weight shells

UNIT III. Shear, adherence and anchorage

Competence:
Implement structural design criteria, considering local and international codes in the shear design and the determination of reinforcement Steel detailing in elements subject to flexural stress, to perform the required analysis in a civil engineering project, with an analytic and critic attitude.

Content : **Duration:** 2 hours

3.1 Shear failure mechanisms
- 3.1.1 Effects of variations of cracking loads.
- 3.1.2 Effects of variations over resistance
- 3.1.3 Equations to evaluate resistance for shear force effects

3.2 Development of adherence stresses
- 3.2.1 Basic development length
- 3.2.2 Development of flexural reinforcement in continuous beams
- 3.2.3 Reinforcement splice
- 3.2.4 Typical details of reinforcement and placement of steel bars

UNIT IV. Flexural-compression design

Competence:
Implement structural design criteria, considering local and international codes in the design of elements in flexural-compression stresses, to perform the required analysis in a civil engineering project, with a proposal and responsible attitude.

Content : **Duration:** 4 hours

4.1 Columns with stirrups and spiral reinforcement.
4.2 Compression and flexion in columns.
4.3 Interaction diagrams in concrete columns.
4.4 Biaxial flexion
4.5 Slenderness effects

UNIT V. Masonry

Competence:
Determine the elements that form masonry structures, through the application of codes and design standards, to have safe structures, with an analytical, critical and creative attitude.

Content : **Duration:** 4 hours

5.1 Mechanical propierties of masonry
5.2 Compression design
5.3 Shear design
5.4 Flexo-compression design

VI. STRUCTURE OF WORKSHOP PRACTICES				
Practice No.	**Competence**	**Description**	**Support material**	**Time**
UNIT I				
1	Recognize the established norms for the design, considering the conditions of load and properties of the structural materials, to distinguish the criteria that are applicable according to the plastic theory of design, with a proactive, critical and responsible attitude.	The teacher delivers a case study guide. The student identifies the predominant characteristics for each of the cases and recognizes the design criteria that must be applied. The student gives the teacher a descriptive report of each case.	Calculator, computer, notes.	2 hours
UNIT II				
2	Analyze the conditions of structural design, through the criteria for bending, to distinguish the regulations established for beams, with an innovative, proactive and responsible attitude.	The teacher prepares a series of application exercises. The student determines in each of the exercises the dimensions and armed in sub-reinforced beams, in accordance with current regulations and specifications. The student gives the teacher a descriptive report of each case.	Calculator, computer, notes.	4 hours
3		The teacher implements a series of application cases. The student calculates for each of the cases the dimensions and assemblies required in doubly reinforced beams, in accordance with current regulations and	Calculator, computer, notes.	4 hours

		specifications. The student delivers the results in an orderly and clear manner of each case.		
4		The teacher provides a list of hypothetical cases. The student identifies for each of the cases the geometric configuration and armed in T beams, in accordance with the current design specifications. The student prepares for the teacher the report of the methodology applied in each case.	Calculator, computer, notes.	4 hours
5	Characterize the design conditions, according to the representative mathematical models in the mechanics of materials to carry out the identification and classification of the types of slabs.	The teacher presents a series of situations regarding types of slabs. The student identifies for each of the cases the geometric configuration and armed in slabs in a sense, according to the current design specifications. The student delivers the results in an orderly and clear manner of each application case.	Calculator, computer, notes.	2 hours
6		The teacher provides a list of hypothetical cases. The student calculates for each of the cases the dimensions and reinforced in solid slabs supported perimetrally, according to the current specifications.	Calculator, computer, notes.	4 hours

		The student gives the teacher a descriptive report of each case.		
7		The teacher exposes different cases for design in architectural projects. The student determines for each of the cases the dimensions and armed in lightweight slabs, in accordance with current regulations and specifications. The student prepares for the teacher the report of the methodology applied in each case.	Calculator, computer, notes.	4 hours
UNIT III				
8	Identify the conditions of implementation of the structural design, using the criteria of resistance by shear, to determine the behavior of the material in beams, with an innovative, proactive and responsible attitude.	The teacher raises a series of application cases. The student calculates for each of the cases the dimensions and armed by shear in beams, according to the criteria established in the current regulations. The student delivers a report with the considerations, methodology and results obtained.	Calculator, computer, notes.	2 hours
9	Characterize the parameters of adherence and length of development, considering the models in the current regulations, to identify the detailed steel longitudinal reinforcement in beams, with an innovative, proactive and responsible	The teacher implements some cases to solve. The student determines for each of the cases the detailed longitudinal reinforcement in beams, in accordance with current regulations. The student gives the teacher a	Calculator, computer, notes.	2 hours

	attitude.	detailed and orderly descriptive memory of each case resolved.		
UNIT IV				
10	Implement the fundamental concepts of materials mechanics, using plastic theory, to evaluate the distribution of stresses to flexo-compression and unitary deformations of reinforcing steel in short columns, with an innovative, proactive and responsible attitude.	The teacher raises a series of application cases. The student determines for each of the cases the calculation of dimensions and armed in short columns, in accordance with current regulations and specifications. The student gives the teacher a descriptive report of each case.	Calculator, computer, notes.	4 hours
11	To characterize the parameters of interaction axial load - bending moment, considering the models in the current normativity, to identify the interaction diagram of short columns, with an innovative, proactive and responsible attitude.	The teacher presents diverse cases of short column configurations. The student determines the axial-moment load interaction diagram, in accordance with current regulations. The student gives the teacher a detailed descriptive memory of the resolution in each case.	Calculator, computer, notes.	4 hours
12	Apply the theory of plastic design, considering the current regulations in the design of long columns, for the design of sections of long columns, with an innovative, proactive and responsible attitude.	The teacher provides a list of hypothetical cases. The student calculates the dimensions and armed in sections of long columns, in accordance with current regulations and specifications. The student gives the teacher a detailed report of the proposed	Calculator, computer, notes.	4 hours

		solution.		
13	Apply the methodology of compatibility of deformations and ultimate resistance, considering the mathematical models available in the current regulations for obtaining the interaction diagram of long columns, with an innovative, proactive and responsible attitude.	The teacher presents different configurations in column sections. The student determines for each of the cases the interaction diagram of long columns, according to the current regulations. The student delivers the results in an orderly and clear manner of each application case.	Calculator, computer, notes.	4 hours
UNIT V				
14	Characterize the parameters of configuration and disposition of resistant elements in the masonry, considering the criteria in the current regulation, to determine the resistance of the masonry in building, with an innovative, proactive and responsible attitude.	The teacher presents cases of masonry requirements in different architectural projects. The student determines for each of the cases the properties of the elements that make up the masonry in buildings, in accordance with current regulations. The student gives the teacher a descriptive report of each case.	Calculator, computer, notes.	4 hours

VII. WORK METHOD

Framing: The first day of class the teacher must establish the form of work, evaluation criteria, quality of academic work, rights and obligations for teacher and students.

Teaching strategy (teacher)

• Exhibition by the teacher in an orderly and consistent manner, the student will receive the fundamentals concerning the analysis and design of structures in the different units of the course.

• Applicable regulations are identified, as well as the types of analysis that can be applied.

• In workshop sessions, practical exercises will be developed on the blackboard with the participation of the students, in which they identify and explore the basic concepts; following with dynamics in working groups for the solution of exercises, being the teacher a monitor and guide of these.

• In addition, it is complemented by task exercises in their individual or team modalities.

• A portfolio of evidences will be presented where the student includes research work, tasks and exercises carried out during the semester.

Learning strategy (student)

• Through teamwork, workshop and experimental sessions

• The student will apply the concepts, principles and codes that govern the design of structural elements of reinforced concrete.

The evaluations will be made periodically where the student will put into practice the knowledge acquired during the course. The exercises elaborated in adherence to reflection and criticism, will position the student in full recognition of the acquired skills that, together with a research process, make it possible to execute and present designs of reinforced concrete structures and according to the project requirements. , in accordance with the requirements of design specifications.

VIII. EVALUATION CRITERIA

The evaluation will be carried out permanently during the development of the learning unit as follows:

Accreditation Criterion

- To be entitled to ordinary and extraordinary exam, the student must meet the attendance percentages established in the current School Statute.
- Scaled from 0 to 100, with a minimum approval of 60.

Evaluation criteria

- 4 written midterms…….60%
- Performance evidence …….....15%
  (Application project of reinforced concrete elements design)
- Homeworks and team work……...25%

Total……100%

IX. REFERENCES

Required

González Cuevas, O. M., & Robles Fernández-Villegas Francisco. (2005). Aspectos fundamentales del concreto reforzado (4a ed.). México: Limusa. [clásica]

Gu, X., Jin, X., & Zhou, Y. (2016). Basic Principles of Concrete Structures. (1st ed. 20). Berlin, Heidelberg: Springer Berlin Heidelberg : Recuperado de: http://148.231.10.114:2048/login?url=http://dx.doi.org/10.1007/978-3-662-48565-1

Hussain, R. R., Wasim, M., & Hasan, S. (2016). Computer Aided Seismic and Fire Retrofitting Analysis of Existing High Rise Reinforced Concrete Buildings (1st ed. 20). Dordrecht: Springer Netherlands. Recuperado de:http://148.231.10.114:2048/login?url=http://dx.doi.org/10.1007/978-94-017-7297-6

McCormac, J. C., Russell H, B., & Arrioja-Juárez, R. (2011). Diseño de concreto reforzado. (8aed.). México: Alfaomega. [clásica]

SIDUE, S. de I. y D. U. del E. de B. C. Normas Técnicas Complementarias de la Ley de Edificaciones del Gobierno de Baja California (2017).

Suggested

ASCE, A. S. of C. E. (2012). ASCE Library. Retrieved September 12, 2018, from https://ascelibrary.org/doi/abs/10.1061/ciegag.0000563

Institute, A. C. (2014). *ACI 318-14 Building Code Requirements for Structural Concrete and Commentary (Metric)*. American Concrete Institute. Retrieved from https://books.google.com.mx/books?id=Z-LGrQEACAAJ

Neville, G. B., Neville, G., Institute, A. C., & Council, I. C. (2015). *Concrete Manual: Based on the 2015 IBC and ACI 318-14*. International Code Council. Retrieved from https://books.google.com.mx/books?id=D1PisgEACAAJ

Setareh, M., & Darvas, R. (2016). *Concrete Structures*. Springer International Publishing. Retrieved from https://books.google.com.mx/books?id=JwTWDAAAQBAJ

X. TEACHER PROFILE

The teacher who teaches the design unit of Concrete and Masonry Structures must have a degree in Civil Engineering, with experience in structural analysis and design. In addition, it must manage information technologies, communicate effectively and facilitate collaboration. Be a proactive, innovative, analytical, responsible person, with a high sense of ethics and capable of proposing methodical solutions to a given problem, with a vocation of service to teaching. Preferably have one year of teaching and work experience.