Course Syllabus

1. **Course Title:** Reinforced Concrete STructures
2. **Course Code:** RCST240617
3. **Credit Units:** 4 (4/0/8) (4 units of theory/ 0 unit of practice/ 8 units of self-study)
   Duration: 15 weeks (4 hours of theory and 8 hours of self-study per week)
4. **Course Instructors:**
   1/ Dr. Phạm Đức Thiện
   2/ Dr. Trần Tuấn Kiệt
   3/ MSc. Đoàn Ngọc Tịnh Nghiêm
5. **Course Requirements**
   Prerequisite courses: Strength of Materials (STMA240121)
   Previous courses: None
   Parallel courses: None
6. **Course Description**
   This is a fundamental engineering module belonging to a group of courses related reinforced concrete structures. The module introduces knowledge of reinforced concrete materials, calculation and design of basically reinforced concrete structural components subjected bending, shearing and tension/compression. In addition, the course also provides fundamental concepts of pre-stressed concrete structures.
7. **Course Goals**

Goals	Goal Description	Programme ELOs
G1	Analyse core knowledge in the field of designing reinforced concrete and pre-stressed concrete structures.	1.2
G2	Analysis and giving possible solutions for design problems of reinforced concrete and pre-stressed concrete structures.	2.1
G3	Be able to present and read documents in English	3.2, 3.3

8. **Course Learning Outcomes (CLOs)**

CLOs		CLO Description	Programme ELOs
G1	**G1.1**	Demonstrate the basic properties and applied field of reinforced concrete and pre-stressed concrete structures.	1.2
	G1.2	Demonstrate basic concept, use design principles for the design of reinforced concrete and pre-stressed concrete structural elements.	1.2
G2	**G2.1**	Analyze procedure of designing reinforced/prestressed concrete structural components	2.1

	G2.2	Compute and design reinforced/prestressed concrete structural components	2.1
	G2.3	Demonstrate results of design in details	2.1
G3	**G3.1**	Develop presentational skills	3.2
	G3.2	Be able to read lecture notes in English	3.3

9. Learning Resources

- Textbooks:

1. Phan Quang Minh, Ngô Thế Phong, Nguyễn Đình Cống, Kết cấu Bê tông cốt thép, phần cấu kiện cơ bản, Nhà xuất bản Khoa học và kỹ thuật
2. Nguyễn Tiến Chương, Kết cấu bê tông ứng suất trước. NXB Xây dựng, Hà Nội, 2010
3. Jack C. McCormac, Russell H. Brown, Design of Reinforced Concrete, 9th Edition, John Wiley & Sons, 2014.
4. Bill Mosley, John Bungey, Ray Hulse, Reinforced Concrete Design to Eurocode 2, 6th Edition, Palgrave Macmillan, 2007. (7th edition, 2012 published)

- References:

1. James K. Wight, James G. MacGregor, Reinforced Concrete - Mechanics and Design, 6th Edition, Pearson Education, 2012.
2. M. Nadim Hassoun, Akthem Al-Manaseer, Structural Concrete - Theory and Design, 5th Edition, John Wiley & Sons, 2012.
3. Arthur Nilson, David Darwin, Charles Dolan, Design of Concrete Structures, 14th Edition, McGraw-Hill Higher Education, 2010.
4. V. Baikov, E. Sigalov, Reinforced concrete structures, Volume 1, 1981.
5. Nguyễn Đình Cống, Tính toán thực hành cấu kiện bê tông cốt thép theo tiêu chuẩn TCXDVN 356:2005, Tập I, Nhà xuất bản xây dựng, 2008.
6. Nguyễn Đình Cống, Tính toán thực hành cấu kiện bê tông cốt thép theo tiêu chuẩn TCXDVN 356:2005, Tập II, Nhà xuất bản xây dựng, 2008.
7. Nguyễn Đình Cống, Tính toán tiết diện cột bê tông cốt thép, Nhà xuất bản xây dựng, 2005.
8. Bộ xây dựng, TCVN 5574:2012, Kết cấu bê tông và bê tông cốt thép – tiêu chuẩn thiết kế, Nhà xuất bản xây dựng, 2012.
9. Phan Quang Minh, Thiết kế sàn bê tông ứng lực trước, Hà Nội, 2007.
10. Nguyễn Tiến Chapter, Kết cấu bê tông ứng suất trước - Chỉ dẫn thiết kế theo TCXDVN 356 : 2005. Nhà XB Xây dựng, Hà Nội, 2010.

10. Student Assessment:

- Grading scale: **10**
- Assessment plan:

Type	Content	Timeline	Assessment method	CLOs	Rate (%)
Chuyên cần					**10**
Exams					**20**
Ex#1	Members in bending	Week 6	+ Individual assessment + Open	G1.2, G1.2, G2.1, G2.2,	20

Type	Content	Timeline	Assessment method	CLOs	Rate (%)
			book exam + Duration: 30~60 minutes	G2.3,	
Exams / Projects					**20**
Ex#2	Members in compression or tension	Week 11	+ Individual assessment + Open book exam + Duration: 30~60 minutes	G1.2, G1.2, G2.1, G2.2, G2.3	20
Pro#1	Study and present topics related to analysis and design of reinforced/prestressed concrete structures according to foreign codes	Week 15	Group-working Presentation	G1.1, G2.1, G3.1, G3.2	20
Final exam					**50**
	The final exam covers some contents delivered in the course and CLOs	Univ. timeline	+Paper assessment or Multiple choice exam + Paper document available + Duration: 60~90 minutes	G1.2, G1.2, G2.1, G2.2, G2.3	

11. Course Content

Week	Content	CLOs
1	***Chapter 1: Introduction to reinforced concrete structures (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 1.1 Introduction 1.2 Co-working of concrete and reinforcement 1.3 Classification 1.4 Advantages and weaknesses 1.5 Applications 1.6 Properties of materials 1.7 Design of reinforced concrete structure 1.8 Loads and load combinations 1.9 Methods of calculations and design 1.10 Principles of reinforcement design	G1.2, G2.1

Week	Content	CLOs
	Pedagogical methods: + Presentation of lecture	
	***B/* Self-study content**: *(8)* + Tables of concrete and reinforcement properties + Exercises about Loads and load combinations + Principles of reinforcement design	G1.2, G2.1
2	***Chapter 2: Members in bending (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 2.1 Introduction + Slabs + Beams + Normal sections – inclined sections 2.2 Analyses of stress – strain at normal sections + Stress – strain at normal sections + Plastic failure – brittle failure 2.3 Design of rectangular beams + Hypotheses + Stress scheme + Formulation + "Plastic failure" condition + Problems **Pedagogical methods:** + Presentation of lecture	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Homeworks - Design of rectangular beams	G1.2, G1.2, G2.1, G2.2, G2.3,
3	***Chapter 2: Members in bending – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 2.4 Examples + Design A_s + Determine M_{gh} 2.5 Rectangular beams, doubly reinforcement + Hyothesis + Stress scheme + Formulation + "Plastic failure" condition + Problems 2.6 Examples + Design A_s	G1.2, G1.2, G2.1, G2.2, G2.3,

Week	Content	CLOs
	+ Determine M_{gh} **Pedagogical methods:** + Presentation of lecture + Applied examples	
	***B/* Self-study content**: *(8)* + Homeworks - Design of rectangular beams (doubly reinforcement)	G1.2, G1.2, G2.1, G2.2, G2.3,
4	***Chapter 2: Members in bending – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 2.7 Design of T-section and I-section beams + Introduction + Classification + Hypotheses + Stress scheme + Formulation + "Plastic failure" condition + Problems + Reviews 2.8 Examples + Design A_s + Determine M_{gh} **Pedagogical methods:** + Presentation of lecture + Applied examples	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Homeworks - Design of T-section and I-section beams	G1.2, G1.2, G2.1, G2.2, G2.3,
5	***Chapter 2: Members in bending – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 2.9 Inclined-section shear strength analysis + Introduction + Principles of calculation + Design of stirrups + Design of inclined-bars 2.10 Examples 2.11 Individual assessment (Ex#1) **Pedagogical methods:** + Presentation of lecture + Applied examples	G1.2, G1.2, G2.1, G2.2, G2.3,

Week	Content	CLOs
	***B/* Self-study content**: *(8)* + Reviews - Members in bending + Homeworks - Design of stirrups and inclined-bars	G1.2, G1.2, G2.1, G2.2, G2.3,
6	***Chapter 3: Members in tension (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 3.1 Introduction + Members in tension + Axial tension and eccentric tension + Reinforcing steel 3.2 Design of members in axial tension + Hypothesis + Conditions and formulation 3.3 Design of members in eccentric tension + Little vs. great eccentric tension + Design of members in little eccentric tension + Design of members in great eccentric tension 3.4 Examples + Design A_s, A'_s + Capacity of members **Pedagogical methods:** + Presentation of lecture + Applied examples	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Homeworks - Design of members in tension	G1.2, G1.2, G2.1, G2.2, G2.3,
7	***Chapter 4: Members in compression (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 4.1 Introduction + Axial compression and eccentric compression + Dimensions of section + Effective length + Slenderness + Reinforcement 4.2 Members in axial compression + Introduction + Conditions and formulation 4.3 Examples + Design of reinforcing steel + Calculation of compressive capacity	G1.2, G1.2, G2.1, G2.2, G2.3,

Week	Content	CLOs
	Pedagogical methods: + Presentation of lecture + Applied examples	
	***B/* Self-study content**: *(8)* + Homeworks - Design of members in axial compression	G1.2, G1.2, G2.1, G2.2, G2.3,
8	***Chapter 4: Members in compression – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 4.4 Members in planar eccentric compression + Introduction + Buckling effect + Cases of eccentric compression + Design of members in planar eccentric compression - Stress scheme - Conditions and formulation - Problems 4.5 Examples + Design of reinforcing steel + Calculation of compressive capacity **Pedagogical methods:** + Presentation of lecture + Applied examples	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Homeworks - Design of members in planar eccentric compression	G1.2, G1.2, G2.1, G2.2, G2.3,
9	***Chapter 4: Members in compression – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 4.6 Members in biaxial eccentric compression + Introduction + Calculation scheme + Practical calculation method + Applied conditions + Formulation **Pedagogical methods:** + Presentation of lecture	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Interaction diagram	G1.2, G1.2, G2.1, G2.2, G2.3,
10	***Chapter 4: Members in compression – cont. (4/0/8)***	

Week	Content	CLOs
	A/* Content and pedagogical methods in class: (4)* **Content:** 4.7 Examples + Design of reinforcing steel + Calculation of compressive capacity 4.8 Interaction diagram + Introduction + Determination of interaction diagram 4.9 Individual assessment (Ex#2) **Pedagogical methods:** + Presentation of lecture + Applied examples	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Reviews - Members in compression	
11	***Chapter 5: Crack resistance (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 5.1 Introduction 5.2 Normal incipient-crack resistance 5.3 Inclined incipient-crack resistance 5.4 Normal crack-opening resistance 5.5 Inclined crack-opening resistance 5.6 Examples **Pedagogical methods:** + Presentation of lecture + Applied examples	G1.2, G1.2, G2.1
	***B/* Self-study content**: *(8)* + Homeworks - Crack resistance	G1.2, G1.2, G2.1
12	***Chapter 6: Pre-stressed concrete (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 6.1 Introduction 6.2 Classification + Pre-tensioning vs. Post-Tensioning + By position of prestressing steel + By types of prestressing steel + Full, limited or partial prestressing + Linear or circular prestressing 6.3 Prestressing methods + Prestressing methods + Pre-tensioning	G1.2, G1.2, G2.1, G2.2, G2.3,

Week	Content	CLOs
	+ Post-tensioning + Anchorages + Post-tensioning process 6.4 Materials 6.5 Design of reinforcing steel + Prestressing tendon profile + Longitudinal steel + Transversal steel + Concrete cover + Reinforcing steel at anchorage zone **Pedagogical methods:** + Presentation of lecture + Group discussion	
	***B/* Self-study content**: *(8)* + Survey on pre-stressed concrete buildings + Advantages and weaknesses of pre-stressed concrete structures + Group project Pr#1	G1.2, G1.2, G2.1, G2.2, G2.3,
13	***Chapter 6: Pre-stressed concrete – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 6.6 Loss of prestress + Introduction 6.7 First loss of prestress + Relaxation of tendons + Temperature difference + Deformation of anchorage + Frictions + Deformation of formwork + Creep of concrete 6.8 Second loss of prestress + Relaxation of tendons + Shrinkage of concrete + Creep of concrete + Elastic shortening of concrete + Deformation of connection **Pedagogical Methods:** + Presentation of lecture + Group discussion	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Calculation of loss of prestress + Group project Pr#1	G1.2, G1.2, G2.1, G2.2, G2.3,

Week	Content	CLOs
14	***Chapter 6: Pre-stressed concrete – cont. (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 6.9 Stress stages + Stage I + Stage II + Stage III 6.10 Calculation methods + Limit stress method + Failure stage method + Limit states method 6.11 First limit state + Calculation requirements + General formula + Limit compressive depth + Content of steel 6.12 Second limit state **Pedagogical methods:** + Presentation of lecture	G1.2, G1.2, G2.1, G2.2, G2.3,
	***B/* Self-study content**: *(8)* + Study on designing of pre-stressed concrete structures + Group project Pr#1	G1.2, G1.2, G2.1, G2.2, G2.3,
15	***Chapter 7: Reviews (4/0/8)***	
	A/* Content and pedagogical methods in class: (4)* **Content:** 7.1 Discussion and evaluation of Pro#1 + Group presentation + Discussion – Evaluation 7.2 Reviews and Conclusions 7.3 Extension **Pedagogical methods:** + Group discussion + Presentation of lecture + Conclusions	G1.2, G1.2, G2.1, G2.2, G2.3, G3.1, G3.2,
	***B/* Self-study content**: *(8)* + Reviews	

12. Learning Ethics

Home assignments and projects must be done by the students themselves. Plagiarism found in the assessments will get zero point.

13. Date of first approval: August 1st, 2012

14. Approved by

Dean	Head of Department	Instructor
A/Prof. Dr. Nguyễn Trung Kiên	**MSc. Nguyễn Văn Hậu**	**Dr. Phạm Đức Thiện**

15. Date and Up-to-date content

1st time: Date:	Instructor: Head of Department: