Kurdistan Region Government
Ministry of Higher Education
and Scientific Research
Erbil Polytechnic University

# Module (Course Syllabus) Catalogue

# 2023-2024

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|---|---|---|
| College/ Institute | Erbil Technical Engineering College | |
| Department | Civil Engineering | |
| Module Name | Hydraulic Structures | |
| Module Code | HYS 701 | |
| Degree | Technical Diploma [ ] Bachler [x]<br>High Diploma [ ] Master [ ] PhD | |
| Semester | 7th | |
| Qualification | B.SC | |
| Scientific Title | Engineer | |
| ECTS (Credits) | 6 | |
| Module type | Prerequisite [ ] Core [x] Assist. [ ] | |
| Weekly hours | 4 hrs | |
| Weekly hours (Theory) | (4) hrs. Class | (162) Total hrs. Workload |
| Weekly hours (Practical) | (0) hr. Class | (0) Total hrs. Workload |
| Number of Weeks | 15 | |
| Lecturer (Theory) | Assist. Prof. Basil Younus Mustafa;<br>Assist. Lecturer Alend W. Abdulrazaq | |
| E-Mail & Mobile NO. | basil.mustafa@epu.edu.iq<br>alend.abdulrazaq@epu.edu.iq | |
| Lecturer (Practical) | N/A | |
| E-Mail & Mobile NO. | N/A | |
| Websites | N/A | |

# Course Book

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| **Course Description** | **The course serves as an introduction to the field design of hydraulic structures. This unit intends to provide basic information by application of basic hydraulic principles and engineering tools in the process of engineering analysis and design. Various forces acting on hydraulic structures are introduced in a unified framework and procedure to design the main body, crossing structures, outlet works, energy dissipation and diversion works of a hydraulic structure.** |
| **Course objectives** | **The course will focus on explaining the background of the hydraulic structures. This module designed to provide a basic knowledge of hydraulic structures design for the final class civil engineering students.**<br>**It provides students the ability to solve engineering problems of hydraulic structures in open channels and rivers by application of basic hydraulic principles and engineering tools in the process of engineering analysis and design. Students will gain experience by solving problem assignments throughout the semesters.** |
| **Student's obligation** | **1. Students should attend the class in order to understand and participate during teaching sessions; otherwise, the lecturer will not be responsible to re- repeat the lecture.**<br>**2. Student absent list will be submitted to the civil engineering department weekly or monthly.**<br>**3. Students will need to submit the required homework, reports, seminars and/or any other assignments requested by the lecturer in time and in accurate method.** |

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| **Required Learning Materials** | **The different types of teaching-learning materials are, video TLMs, textbooks, overhead projector, Power Point slides, computers and other reading materials.**<br>**Other Reading Materials: The other reading materials are referred to articles, documents, reports, assignments, projects, newspapers, magazines and books.** |

**Evaluation**

| Task | | Weight (Marks) | Due Week | Relevant Learning Outcome |
|---|---|---|---|---|
| Paper Review | | | | |
| Assignments | Homework | 10% | 4,6,10,11 | 1,2,3,4 |
| | Class Activity | 2% | 1-12 | 1-4 |
| | Report | 8% | 6 | 1,2,3,4 |
| | Seminar | 8% | 10 | 1,2,3,4 |
| | Essay | | | |
| | Project | | | |
| Quiz | | 8% | 4,6,8,11 | 1,2,3,4 |
| Lab. | | N/A | | |
| Midterm Exam | | 24% | 7-8 | 1-3 |
| Final Exam | | 40% | 13-15 | 1-4 |
| Total | | 100% | | |

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| **Specific learning outcome:** | **By the end of the course, students should be able to**<br>**1- Analyse and design of hydraulic structures using relevant code of practice. Apply the basic design principles to engineering design practice and it develops the ability to determine energy losses and flow capacity of basic hydraulic structures.**<br>**2- Apply the basic design principles to engineering design practice and it develops the ability to design weirs and barrages on rivers for water diversion into canals and other head work structures required for rivers water diversion like gates, wing walls, fish ladders…etc.** |

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| | **3- Apply the basic design principles to engineering design practice and it develops the ability to design canal and road crossing structures.**<br>**4- Obtaining information about the types of dams and storage works, and planning.** |
| **Course References:** | ▪ **Key references:**<br>**1- Theory and design of irrigation structures, II, by R.S. Varsheny & S.C. Gupta.**<br>**2- Irrigation & water power engineering, by B.C. Punma & Pande Lal.**<br>▪ **Useful references:**<br>**1- Small earth dams by USBR**<br>**2- Earth and earth rock fill dams, by James L. Sherard** |

| **Course topics (Theory)** | **Week** | **Learning Outcome** |
|---|---|---|
| **Ch.1: Introduction** | **1** | **1** |
| **Ch.2: Hydraulic structures on permeable foundation and seepage problems: Seepage, Causes of failure of hydraulic structures, Design of impervious floor for sub-surface flow.** | **2** | **1** |
| **Ch.3: Hydraulic Jump & Energy Dissipaters** | **3** | **1** |
| **Ch.4-1: Canal Head works. Barrage Design criteria.** | **4, &5** | **2** |
| **Ch.4-2: Design of Vertical drop Weir** | **6** | **2** |
| **Ch.5: Canal Regulators: Design of Main Canal Head Regulator** | **7** | **2** |
| **Ch.6: Canal Crossing Structures: Design of Culverts** | **8, & 9** | **3** |
| **Ch.7: Storage Works, Reservoir planning, Dams and types of the dams** | **10** | **4** |
| **Ch.8: Gravity dams, Forces acting on gravity dam, Stability requirement of gravity dams, and Elementary profile of a gravity dams** | **11, &12** | **4** |
| **Ch.9: Embankment dams, Earth dams or earth fill dams, Rock-fill dams.** | **13** | **4** |
| **Practical Topics N/A** | **Week** | **Learning Outcome** |

# Questions Example Design

**Ex. A vertical drop weir is to be designed on a river, having the following data: Design Q = 280 $m^3/s$, HFL in the river before construction = 367m, pond level = 366.5 m, river bed level = 363.5 m, waterway width = 40m, allowable afflux =1m, silt factor (f) = 1, safe GE=1/5, retrogression = 0.5m, and the specific gravity of the concrete =2.24. Design, The crest wall level and dimensions.**

**Answer:** $q_{avg}$ **(average discharge intensity)** $= \frac{280}{40} = 7\ m^3/s/m$

**Scour depth,** $R = 1.35 * (\frac{q_{avg}^2}{f})^{\frac{1}{3}} = 1.35 * (\frac{7^2}{1})^{\frac{1}{3}} = 4.94\ m$

**and** $V = \frac{q}{R} = \frac{7}{4.94} = 1.417\ m/s$**, then** $\frac{V^2}{2g} = \frac{1.417^2}{2*9.81} = 0.1\ m$

**DS HFL = River HFL before construction = 367 m**

**US HFL = DS HFL + Afflux = 367+ 1 =368 m**

$$\text{US TEL} = \text{US HFL} + \frac{V^2}{2g} = 368 + 0.1 = 368.1\ m$$

$$\text{DS TEL} = \text{DS HFL} + \frac{V^2}{2g} = 367 + 0.1 = 367.1\ m$$

$$\text{Actual DS HFL} = 367 - 0.5 = 366.5\ m$$

**US bed level = river bed level = 363.5 m**

**q = C He $^{3/2}$ $\Rightarrow$ for weir** $q_{act} = q_{avg} \Rightarrow 7 = 1.7 * He^{3/2} \Rightarrow$ **He = 2.57 m**

**Crest level of the weir = US TEL-He = 368.1 – 2.57= 365.53 m**

**Pond level at US of the weir = 366.5 m**

**Pond level is higher than crest level of the weir this difference will be controlled by crest shutter:**

**Height of crest shutter (S) = pond level – crest level= 366.5 - 365.53 =0.97m**

**Height of weir crest wall (H) = crest level – US floor bed level = 365.53 – 363.5= 2.03 m**

**Top width of the crest wall (a) will the greatest of the followings**

$a = \frac{H_e}{\sqrt{G_S}} = \frac{2.57}{\sqrt{2.24}} = 1.717m$ , $a = \frac{3*2.57}{2*2.24} = 1.721\ m$, and $a = S + 1 = 0.97 + 1 = 1.97m$

**Provide a = 2 m.**

$M_o = \frac{\gamma_w * d * H^2}{2}$ , **d = water head over crest = US HFL – Crest level = 368 – 365.53 = 2.47 m**

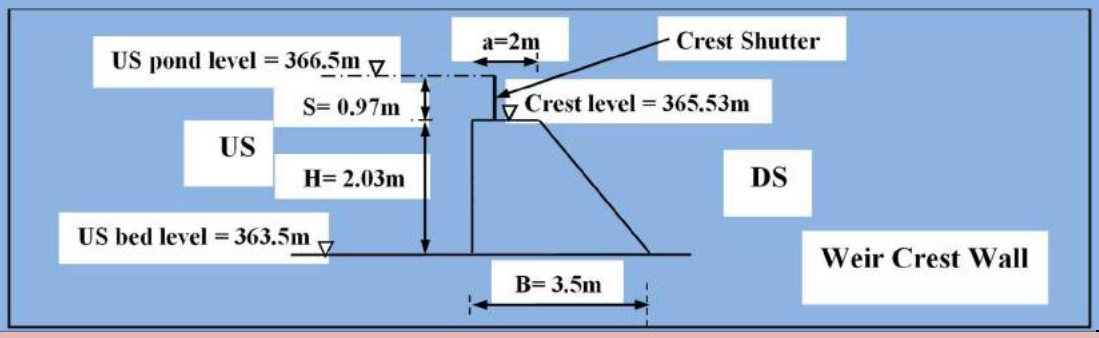
$$M_o = \frac{1*2.47*2.03^2}{2} = 5.089\ tom.m$$

$$M_r = \left\{\frac{\gamma_w * H * (G_s - 1)}{6}\right\} * \{B^2 + a * B - a^2\} = \left\{\frac{1*2.03*(2.24-1)}{6}\right\} * \{B^2 + 2 * B - 2^2\}$$

$$M_r = 0.4195\{B^2 + 2B - 4\}$$

$$M_o = M_r \Rightarrow 5.089 = 0.4195\{B^2 + 2B - 4\}$$

$$B = 3.15\ m\ , provide\ B = 3.5\ m$$




## Extra notes:

## External Evaluator

**I have reviewed the contents of the course book and the syllabus of the subject covers all the important information of Engineering Hydrology subject for 3rd year civil engineering students, and I approve the contents of the course book.**

**Prof. Dr. Mereen Hassan Fahmi**
**Professor in Civil Engineering**