Module (Course Syllabus) Catalogue

2023-2024

College/ Institute	Engineering technical college	
Department	Highway And Bridges	
Module Name	Advanced PAVEMENT Engineering	
Module Code	APE202	
Degree	Technical Diploma ☐ Bachelor OK High Diploma ☐ Master OK PhD ☐	
Semester	SECOND	
Qualification		
Scientific Title	Assistant professor	
ECTS (Credits)	6	
Module type	Prerequisite ☐ Core OK Assist. ☐	
Weekly hours	3	
Weekly hours (Theory)	(3)hr Class	(0)Total hrs Workload
Weekly hours (Practical)	(0)hr Class	(0)Total hrs Workload
Number of Weeks	12	
Lecturer (Theory)	Ass. Pro. Dr. FARIS M. JASIM	
E-Mail & Mobile NO.	Faris.jasim@epu.edu.iq....07507587248	
Lecturer (Practical)		
E-Mail & Mobile NO.		
Websites		

Course Book

Course Description	Increase student knowledge and learn the principles and practices for the investigation, design, contracting, and construction of different types of pavements, including maintenance and rehabilitations processes for more durable with high performance active highway system Highway pavements are divided into two main categories: rigid and flexible. Th wearing surface of a rigid pavement usually is constructed of Portland cement concrete such that it acts like a beam over any irregularities in the underlying supporting material. The wearing surface of flexible pavements, on the other hand, usually is constructed of bituminous materials such that they remain in contact with the underlying material even when minor irregularities occur. Flexible pavements usually consist of a bituminous surface under laid with a layer of granular material and a layer of a suitable mixture of coarse and fine materials. Traffic loads are transferred by the wearing surface to the underlying supporting materials through the interlocking of layers .
Course objectives	The main objectives to be achieved after the completion of this course are summarized below: 1. To understand pavement engineering, terminology, and concepts. 2. To understand the different types of pavements. Ministry of Higher Education and Scientific research Page 3 of 12 3. To recognize the different types of flexible pavements as well as rigid pavements. 4. To get to know and understand the engineering properties and characteristics of the different materials that concern the pavement engineer. 5. To understand testing and evaluation of soil, granular, and bituminous materials for pavement analysis and design. 6. To understand the different Superpave aggregate tests and requirements. 7. To be familiar with the Superpave asphalt binder tests and specifications. 8. To conduct analysis of flexible pavements for stresses, strains, and deflections in one-, two-, and three-layered systems. 9. To conduct analysis of different types of drainage systems with their suitable design for highway 10. To conduct analysis of rigid pavements for stresses, strains, and deflections. 11. To design flexible pavements using the AASHTO design procedure. 12. To design rigid pavements using the AASHTO design procedure. 13.Introduce the student to certain case studies 12. Safety, and oral/Written Communication
Student's obligation	**Student's obligation** a. To attend the classes regularly with minimum absence. b. To participate actively in the class discussion and Q&A session

	c. Study on daily basis to digest the class material d. To write note off-handouts e. Prepared for sudden Quizzes f. through the references provided by the lecturer and to solve as much as possible of homework and exercises for the subjective materials. Prepare the assignment and the seminar as instructed by the lecturer.

Required Learning Materials Evaluation

Task		Weight (Marks)	Due Week	Relevant Learning Outcome
Paper Review				
Assignments	Homework	10		
	Class Activity	2		
	Report	8		
	Seminar	8		
	Essay			
	Project			
Quiz		8		
Lab.				
Midterm Exam		24		
Final Exam		50		
Total		100		

Specific learning outcome:

By the end of the current course, the student shall be able to learn the major activities related to the pavement design which is the part the makes the backbone for any constructional project. This course is aimed at providing the Highway Engineering students with basic understanding of the Highway Engineering materials and the basic and fundamental design concept of highway pavements structures. Students will be able to design and analyse flexible pavements in addition, they will be able to understand the basic elements of rigid pavement design. Students will be able to conduct a thorough analysis of stresses, strains and deflections developed by different axle configurations and loads in multilayer flexible pavement structures. Students will study the effect of both traffic and environment on pavement damage. The pavement course provide sufficient coverage of highway materials using SUPERPAVE characterisation methods, hot mix asphalt design by using Marshall design methods. Students will learn how to design new pavement structure Ministry of Higher Education and Scientific research Page 4 of 12 using Mechanistic-Empirical Pavement Design and by using empirical design methods such as AASHTO guide 1993 method. Students will also learn how to evaluate the structural capacity of an existing pavement structure by utilising the surface deflection measurements and back analysis (back calculation) methods. Overlay design will also be covered

Course References:

1-Pavement Design, Materials, Analysis, and Highways, July,2020 ,First Edition By:M. Rashad Islam, Colorado State University , Pueblo, Colorado Rafiqul A. Tarefder, University of New Mexico, Albuquerque, New Mexico

	Principles of 2-Highway Engineering and Traffic Analysis, Fifth Edition -2013 by , Fred L. Mannering and Scott S. Washburn,,,,Purdue university ,USA 3-Highway and traffic engineering …by N.J. Garber and L.A. Hoel,,2009 4th edition.. University of Virginia,USA 4-Pavemen Design and Materials by A.T. Papagiannakis and E.A.Masad. 2007….University of Texas USA Foundation Analysis and Design: Joseph E. Bowles 5- SORP- 2007

Course topics (Theory)	**Week**	**Learning Outcome**
1-Introduction	1	
2-MATERIALS PROPERTIES AND TESTING	2	
3. SOIL ENGINEERING AND EARTHWORK	3	
4. GRANULAR TYPES AND EVALUATIN	4	
5. DRAINAGE DESIGN	5	
6. BITUMINOUS and PORTLAND CEMENT AS Binder MATERIALS REQUIREMENTS	6.7	
7. PAVEMENT MIX DESIGN (Marshall and Superpave methods)	8,9	
8. PAVEMENT LAYERS DESIGN (AASHTO E-1993 , PCA ,and M-E /2008) a-flexible pavement design b- rigid pavement design c- Runway and Taxiway design d-composite design	10,11	
9. HIGHWAYS MAITENANCE AND REHABILITATION	12	
Pavement sustainability	13	

Practical Topics	**Week**	**Learning Outcome**

Questions Example Design

Ministry of Higher Education & Scientific Research
Erbil Polytechnic University
Erbil Technical Engineering College
Highway Engineering Dept.

Academic Year 2020 – 2021
Final Year Exam. (2nd Trial)

Class: Fourth
Subject: Pavement Design
Code: HE407
Date: 20 / 06 /2021
Time: (3) hrs.

Note: 1- Open books and notes
2-Assume any missing data

Q-1- (*40 mark*):

A rigid pavement is designed with a 11-inch slab, an *Ec* of 6 million lb/in^2, a concrete modulus of rupture of 650 lb/in^2, a load transfer coefficient of 3.1, an initial PSI of 4.7, and a terminal serviceability index of 2.5. The overall standard deviation is 0.35, the modulus of subgrade reaction is 160 lb/in^3 (exist bed rock within 7 ft level and using unbound granular subbase , 20 cm thickness has CBR =25%) , and a reliability of 92% is used along with a drainage coefficient of 0.8. The pavement is designed assuming traffic is ESAL of trucks (AADT=210 per day), (the effect of all other vehicles is ignored). A section of this road is to be replaced (due to different subgrade characteristics) with a flexible pavement having a structural number of 5 and is expected to last the same number of years as the rigid pavement. What is the assumed soil resilient modulus using AASHTO method ? (Assume all other factors are the same as for the rigid pavement.)

Q-2 (25 mark)

According to the available data in table shown below related to sieve analysis of aggregate used (determine all the desired blend gradation for each sieve and all blend ratios) depending on trial and errors concept (passing and retained %) , mixed with asphalt cement (G_b = 1.015). Calculate the volumetric-mass properties of a compacted HMA binder layer (VA,VMA, and VFA), after finding G_{sb}, G_{mm}, and G_{se} at OAC% , where AV= 4% ?

Table 1……..Aggregate gradation analysis

Sieve Size (mm)	Filler	0-5 mm	5-12 mm	12-25 mm	Desired Blend Gradation	Specifications limits
19.1	100.0	100.0	100	100	.....	100
12.7	100.0	100.0	93	13	.....	75-95
9.5	100.0	100.0	35	4	.....	56-80
4.75	100.0	80.0	1	0	.....	35-60
2.36	100.0	63	0	0	.....	23-43
0.300	100.0	10	0	0	.....	5-17
0.075	93.0	1	0	0	.....	4-10
					.....	
					.....	
G_{sb}	2.577	2.638	2.648	2.672		
Blend Ratio %	.....	.....	.....	.....		

Q-3-(15 mark)

A set of 0.75-in.-diameter dowel bars are placed 18 in. on center in a 12-ft-wide concrete Slab, (thickness=9 in.), as shown in Fig. below Two loads (12,000 lb each) are applied at A , and B as shown. Assume the full efficiency of the dowel bars. The modulus of subgrade reaction is 430 pci; the concrete modulus is 3,500 ksi and Poisson's ratio is 0.19.

Determine the force distribution in the dowel bars ?

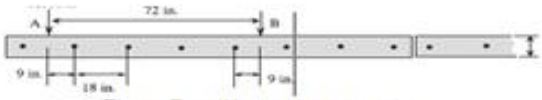


Figure: Dowel bars arrangements

Q/4- (20 mark)

The aggregate mix used for the design of an asphalt mixture consists of 38% coarse aggregates, 50% fine aggregates, and 8% mineral fillers. If the respective bulk specific gravities of these materials are 2.62, 2.72, and 2.67, and the effective specific gravity of the aggregates is 2.810, determine the optimum asphalt content(both methods , asphalt institute and NAPA with execute comparative between them) as a percentage of the total mix if results obtained using the Marshall Design method are shown in the following table. The specific gravity of the asphalt is 1.03.

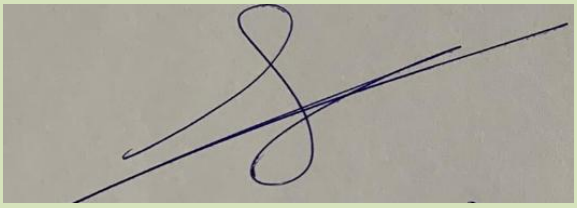
Asphalt %	Weight of specimem (g)		Stability (kN)	Flow (mm)
	In air	In water		
5.5	1325	786	7	1
6	1330	794	9	2
6.5	1336	801	10	4
7	1342	804	8	6
7.5	1348	805	6	7

Good Luck

Examiner: Ass. Pro. Dr. Faris M. Jasim

Extra notes:

External Evaluator



M. Bafreen Chalabi