GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code : ME02000231

Course / Subject Name : Structural Design of Hydraulic Structures

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Core Course

Prerequisite:	Irrigation Engineering, Design of Hydraulic Structures
Rationale:	To discuss design methodology for dams, spillways and energy dissipators

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Calculate various types of forces and stresses acting on hydraulic structures.
02	Carry out seepage and stability analysis and compute factor of safety.
03	Analyse and design of various types of dams, flood protection walls, spillways and energy dissipators
04	Have basic understanding of various instrumentation and surveillance used for Dam safety

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Hydraulic Projects and Hydraulic Structures**	**4**	**5**
	Necessity of Hydraulic Structures, Types of Hydraulic Structures, Layout of Hydraulic Projects, Planning and Design of Hydraulic Projects, Study on Material Properties.		
2.	**Actions, Analysis and Design criteria for Hydraulic Structures**	**8**	**20**
	Actions on Hydraulic Structures and Their Effect Combinations, Analysis of Action Effects for Hydraulic Structures, Design Criteria and Methods for Hydraulic Structures.		
3.	**Gravity Dams and Flood Protection Walls**	**11**	**25**
	Forces acting on failure of a gravity dam, stress analysis, elementary profile, design of gravity dam, other functional features of a gravity dam. Analysis and design of flood protection walls, Gabion Walls.		
4.	**Embankment Dams**	**6**	**15**
	Types, design considerations, seepage analysis and control, stability analysis, construction techniques		
5.	**Spillways**	**7**	**15**
	Types and their design, Ogee spillway, Chute and side spillway, Shaft spillway, Labyrinth and Piano Key Weirs, spillway gates, cavitation, aerators, inflatable rubber weirs, stepped spillway, nappe and skimming flow		
6.	**Energy Dissipators**	**6**	**15**
	Necessity, Types and their selection, design of hydraulic jump type		

	stilling basins, Bucket and Flip type energy dissipators, Impact and pipe outlet		
7.	**Dam safety: instrumentation and surveillance**	**3**	**5**
	Introduction, Instrumentation, Surveillance, Dam Safety Investigation, Reservoir hazard and risk assessment		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
05	**15**	**15**	**25**	**20**	**20**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Hydraulic Structures – Sheng-Hong Chen, Springer.
2. Hydraulic Structures – P. Novak, A.I.B. Moffat and C. Nalluri, R. Narayanan, CRC Press.
3. Hydraulics of spillways and energy dissipators, – Khatsuria R. M., CRC Press
4. Energy Dissipation in Hydraulic Structures – Hubert Chanson, CRC Press.
5. Energy Dissipators: IAHR Hydraulic Structures Design Manuals, – Hager W.H. and Vischer D.L., CRC Press.
6. Hydro Power Structures – Varshney R. S., Nem Chand & Bros., Roorkee.
7. Engineering for Embankment Dams – Varshney R. S., A. A. Balkema Publishers
8. Embankment Dam and Engineering – Singh B. and Varshney R. S., Nem Chand & Bros., Roorkee.
9. Engineering for Dams, Vol I & Vol II – Creager W. P., Justin J. D. W. and Hinds J., John Wiley & Sons
10. Hydraulic design of stilling basins and energy dissipators – Peterka A. J., USBR Engineering Monographs No. 25

11. Design of Small Dams-Third Edition, A Water Resources Technical, Publication – US Bureau of Reclamation
12. Computational Geomechanics and Hydraulic Structures – Sheng-Hong Chen, Springer
13. IS Codes: IS 8826, IS 10135, IS 11772, IS 18662, IS 5186, IS 6512, IS 6934, IS 7365, IS 11973.

(b) Open source software and website:

https://ndl.iitkgp.ac.in/
https://nptel.ac.in/

Suggested Course Practical List:

Practical work shall consist of preparing excel spreadsheets for analysis and design of hydraulic structures as per the latest Indian Standards and hands-on training of finite element software and verification with manual calculations. A design project shall be given to bridge the theory and practice.

List of Laboratory/Learning Resources Required:

Professional Software: Midas FEA, SAP2000, Sofistik, Abaqus, ANSYS

Suggested Project List: --- Analysis and Design of a hydraulic project using available computer packages and verify with manual calculations.

Suggested Activities for Students: --- Acquaints with 3D FEM software packages.

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