JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -1 EXAMINATION- 2026
M.Tech-II Semester (CE-Structural Engineering)

COURSE CODE (CREDITS): 25M1WCE232 (3) MAX. MARKS: 15

COURSE NAME: BRIDGE ENGINEERING

COURSE INSTRUCTORS: Dr. KAUSHAL KUMAR MAX. TIME: 1 Hour

Note: *(a) All questions are compulsory.*
(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems
(c) Calculator is allowed.

<table>
<tr><th>Q.No</th><th>Question</th><th>CO</th><th>Marks</th></tr>
<tr><td>Q1.</td><td>With the help of neat sketch, explain different components of a bridge. Lists out different types of bridge based on span length.</td><td>1</td><td>3</td></tr>
<tr><td>Q2.</td><td>Rain falls on a 300 ha composite catchment which drains two subareas as follows: (1) Subarea X, steep, draining 30% with concentration time 20 min and $C = 0.75$ and (2) Subarea Y, mild, draining 70% with concentration time 60 min and $C = 0.35$.
Calculate the peak runoff corresponding to 25-year frequency. Use the following IDF function: $I = \frac{1000T^{0.2}}{(t_r+20)^{0.7}}$
where I = rainfall intensity in mm/h, T = return period in years, and t_r = rainfall duration in minutes. Assume linear concentration at the catchment outlet</td><td>1</td><td>3</td></tr>
<tr><td>Q3.</td><td>The approximate costs of one superstructure and one pier for a multispan bridge are given below. Estimate the economic span
<table>
<tr><th>Span (m)</th><th>Superstructure Cost (Rs)</th><th>Sub-structure Cost (Rs)</th></tr>
<tr><td>15</td><td>60,000</td><td>80,000</td></tr>
<tr><td>20</td><td>90,000</td><td>85,000</td></tr>
<tr><td>25</td><td>160,000</td><td>90,000</td></tr>
</table></td><td>1</td><td>3</td></tr>
<tr><td>Q4.</td><td>Design the waterway for a bridge over a trapezoidal channel having the side slope of 1:1 with a discharge of 40 cumecs, bed fall of 1:1000 and a bed width to depth ratio of 5:1. The bed material can withstand a safe velocity of 3.0 m/s. The afflux is limited to 10 cm. Take Manning coefficient $n = 0.025$.</td><td>1</td><td>3</td></tr>
<tr><td>Q5.</td><td>A stream with hard banks has a width of 85 m. Its bed is alluvial ($f = 1.1$) and discharge through the section is 600 m^3/s. Calculate the maximum scour depth under the bridge having a single span of 45 m.</td><td>1</td><td>3</td></tr>
</table>

Helpful Formulas:

- Rational formula for Peak Discharge:	$Q = 0.273CIA$
- Kirpich formula for t_c	$t_c = \dfrac{0.06628L^{0.77}}{S^{0.385}}$
- Hathaway formula for t_c	$t_c = \dfrac{0.606(Ln)^{0.467}}{S^{0.234}}$
- ***Molesworth formula for Afflux***	$x = \left(\dfrac{v^2}{17.9} + 0.015\right)\left(\dfrac{A^2}{a^2} - 1\right)$
- ***Marriman's formula for Afflux***	$x = \dfrac{v^2}{2g}\left[\left(\dfrac{A}{Ca}\right)^2 - \dfrac{A}{A_1}\right]$
- ***Drown Weir formula for Afflux***	$x = \dfrac{v^2 d^2}{2g(d+x)^2}\left[\dfrac{L^2}{C^2 L_1^2} - 1\right]$
- ***Normal scour depth for alluvial streams***	$d = 0.473\left(\dfrac{Q}{f}\right)^{1/3}$
- ***Normal scour depth for Quasi-alluvial streams, when the width of the stream is very large compared to the depth.***	$d = \dfrac{1.21Q^{0.63}}{f^{0.33} w^{0.60}}$
- ***Normal scour depth for streams, when the With constriction***	$d' = d\left(\dfrac{w}{L}\right)^{0.61}$