KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2017

(Regulation 2015)

Fourth Semester

CIVIL ENGINEERING

U15CET403**:** Applied Hydraulics and Hydraulic Machinery

COURSE OUTCOMES

CO1:   Design most economical section for an open channel

CO2:   Analyze critical flow conditions in channels

CO3:   Determine GVF profiles under non-uniform flow

CO4:   Select appropriate type of turbines for the given conditions

CO5:   Suggest the type of pumps required for specific purpose

CO6:   Design the characteristics of the pump and turbine for a given efficiency

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1.   Matching type item with multiple choice code   CO4   [K_2]

List I	List II
A.Propeller	i. Inward flow reaction
B.Francis	ii. Tangential flow impulse
C.Kaplan	iii. Axial flow reaction with fixed vanes
D.Pelton	iv. Axial flow reaction with adjustable vanes

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	ii	iv

2.   The channel section which gives the highest efficiency is   CO1   [K_1]

a)   rectangular   b)   trapezoidal

c)   circular   d)   triangular

3. Centrifugal pumps have which of the following advantages? CO6 [K$_2$]

Low initial cost

Compact, occupying less floor space

Easy handling of highly viscous fluids

Select the correct answer using the code given below:

a) 1,2 & 3
b) 1,3
c) 1,2
d) 2,3

4. Francis, Kaplan and propeller turbines fall under the category of CO4 [K$_1$]

a) Axial flow turbines
b) Mixed flow turbines
c) Reaction turbines
d) Impulse turbines

5. Assertion (A): To have maximum hydraulic efficiency, the trapezoidal section of an open channel should be a half-hexagon. CO1 [K$_2$]

Reason (R): For any cross-section, a hexagon has the least-perimeter.

a) Both A and R are Individually true and R is the correct explanation of A
b) Both A and R are Individually true but R is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

6. Specific energy of a channels cross section is equal to CO2 [K$_1$]

a) Sum of its velocity and pressure
b) Sum of its velocity head and pressure head
c) Sum of its velocity head, static head and pressure head
d) Sum of its kinetic energy and depth

7. Consider the following types of water turbines: CO4 [K$_2$]

    1. Bulb 2. Francis 3. Kaplan 4. Pelton

The correct sequence of order in which the operating head decreases while developing the same power is

a) 2-3-4-1
b) 1-3-2-4
c) 3-1-4-2
d) 4-2-3-1

8. A hydraulic jump occurs in a channel CO3 [K$_1$]

a) Whenever the flow is supercritical
b) If the flow is controlled by a sluice gate
c) If the bed slope changes from mild to steep
d) If the bed slope changes from steep to mild

9. Assertion (A): Pump lifts water from a lower level to a higher level.   CO5 [K₂]

   Reason (R): In pump, mechanical energy is converted into pressure energy.

   a) Both A and R are Individually true and   b) Both A and R are Individually true but
       R is the correct explanation of A   R is not the correct explanation of A

   c) A is true but R is false   d) A is false but R is true

10. The profile in which normal depth equals critical depth is   CO3 [K₁]

    a) Mild slope profile   b) Critical slope profile

    c) Steep slope profile   d) Adverse slope profile

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11. Define the term most economical section of a channel.   CO1 [K₁]

12. Differentiate between uniform and non-uniform flow.   CO1 [K₂]

13. Calculate the specific energy of 8 m wide channel conveying 15 m^3/sec of water at a depth of   CO2 [K₂]
    1.2 m.

14. What is a specific energy diagram?   CO2 [K₁]

15. How a positive surge is different from a negative surge?   CO3 [K₂]

16. How will you calculate the length of a hydraulic jump in a rectangular channel?   CO3 [K₂]

17. What are reaction turbines? Give examples.   CO4 [K₁]

18. What is called as cavitation in turbine?   CO4 [K₂]

19. Why priming is necessary in centrifugal pumps?   CO5 [K₂]

20. How a single acting reciprocating pump is different from double acting reciprocating pump?   CO6 [K₂]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. An irrigation channel of trapezoidal cross section, having side slopes 1.5H: 1V is to   CO1 [K₃]
    carry a flow of 10 m^3/s on a bed slope of 1 in 5000. The channel is to be lined for which
    the Manning's roughness coefficient n = 0.012. Find the dimensions of the most
    economic cross section of the channel.

22. Derive the best conditions for a rectangular section to be called as most efficient section. CO1 [K₃]

23. The discharge of water through a rectangular channel of width 8 m, is 15 m3/s when depth of flow is 1.2 m. Calculate i) Specific energy of the flowing water ii) Critical depth and critical velocity iii) Value of minimum specific energy. CO2 [K₂]

24. At a certain section A in rectangular channel of bed width 2 m the depth of flow is 1.2 m. When the flow rate is 6 m^3/s, estimate the distance from A to another section B where, the depth is 1.4 m. The bed slope is 0.002 and Manning's n = 0.015. Use direct step method for GVF profile. CO3 [K₂]

25. The following data is given for a Francis Turbine. Net head H= 60m; speed =700 rpm; shaft power = 293 kW; overall efficiency =84%; flow ratio =0.20; breadth ratio n=0.1; outer diameter of the runner = 2 x inner diameter of the runner. The thickness of vanes occupies 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine Guide blade angle, diameters of runner at inlet and outlet, runner vane angle at inlet and outlet and width of the wheel at inlet. CO4 [K₂]

26. A centrifugal pump is running at 1000 rpm. The outlet vane angle of the impeller is 45 degree and the velocity of flow at outlet is 2.5 m/s. The discharge through the pump is 200 litres/sec when the pump is working against a head of 20m. If the manometric efficiency of the pump is 80% determine the diameter of the impeller and the width of the impeller at outlet. CO6 [K₂]

27. A double acting reciprocating pump has piston of diameter 250 mm and piston rod of diameter 50 mm which is on one side only. Length of piston stroke is 350 mm and speed of crank moving the piston is 60 r.p.m. The suction and delivery heads are 4.5 m and 18 m respectively. Determine the discharge capacity of the pump and the power required to operate the pump. CO6 [K₂]

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