

KATHMANDU UNIVERSITY
End Semester Examination
August, 2018

Marks scored:

Level : B.E.
Year : III

Course : CIEG 314
Semester: II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date AUG 19 2018

SECTION "A"

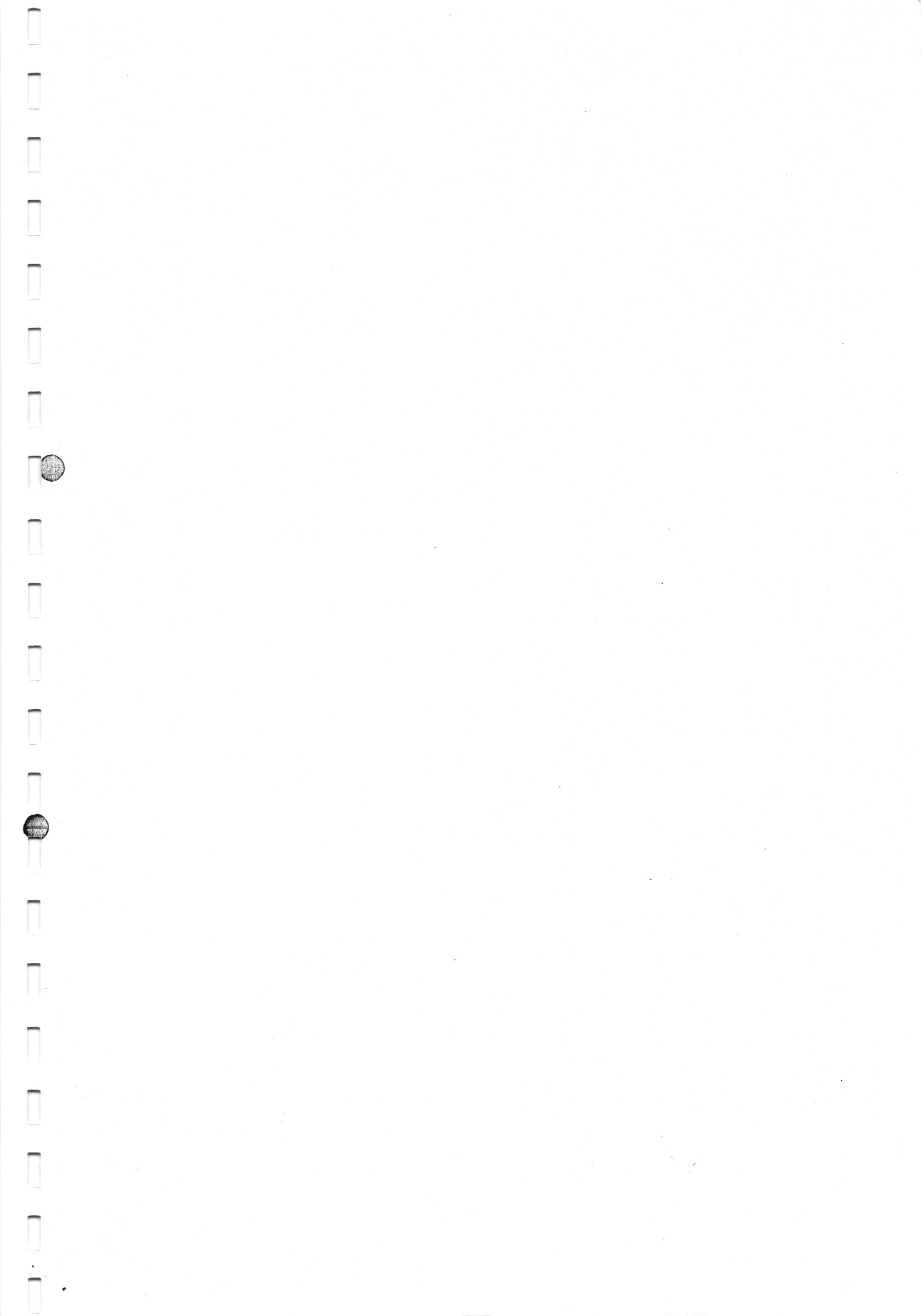
[20 Q. \times 0.5 = 10 marks]

Encircle the most appropriate answer.

- For maximum efficiency of a series of curved vanes, the vane speed is
 - Equal to the jet speed
 - $\frac{3}{4}$ of the jet speed
 - $\frac{1}{2}$ of jet speed
 - $\frac{1}{3}$ of jet speed
- Braking jet in an impulse turbine is used
 - To break the jet of water
 - To bring the runner to rest in a short time
 - To change the direction of runner
 - To bring the runner to motion in a short time
- Which of the following statements is correct?
 - In an impulse turbine, the water impinges on the buckets with pressure energy.
 - In a reaction turbine, the water glides over the moving vanes with kinetic energy.
 - In an impulse turbine, the pressure of the flowing water remains unchanged and is equal to atmospheric pressure.
 - In a reaction turbine, the pressure of the flowing water increases after gliding over the vanes.
- In Kaplan turbine runner, the number of blades are generally between
 - 2 to 4
 - 8 to 16
 - 16 to 24
 - 4 to 8
- A Pelton wheel develops 1750 kW under a head of 100 meters while running at 200 r.p.m. and discharging 2500 liters of water per second. The unit power of the wheel is
 - 0.25 kW
 - 0.75 kW
 - 1.75 kW
 - 3.75 kW
- The cavitation in hydraulic machine is mainly due to
 - Low velocity
 - Low pressure
 - High pressure
 - High velocity
- The specific speed of a hydraulic turbine depends upon
 - Speed and power developed
 - Discharge and power developed
 - Speed and head of water
 - Speed, power developed and head of water

8. Jet ratio (m) is defined as the ratio of
- Diameter of jet of water to diameter of Pelton wheel
 - Velocity of vane to the velocity of jet of water
 - Velocity of flow to the velocity of jet of water
 - Diameter of Pelton wheel to diameter of the jet of water
9. Tick mark the correct statement
- Curves at constant speed are called main characteristics curves.
 - Curves at constant head are called main characteristics curves.
 - Curves at constant efficiency are called operating characteristics curves.
 - Curves at constant efficiency are called main characteristics curves.
10. Governing of a turbine means
- The speed is kept constant under all conditions
 - The discharge is kept constant under all conditions
 - The speed and discharge is kept constant under all conditions
 - The head is kept constant under all working conditions
11. Which one of the following statements is not correct?
- Draft tubes decrease efficiency of a turbine.
 - Wheels of a reaction turbine must always run full.
 - When the load on a reaction turbine is decreased, the system reduces quantity of flow of water in an immersed flow reaction turbine and reduce the power produced.
 - Pelton wheels are impulse turbine.
12. The movable wicket gates of a reaction turbine are used to:
- Control the flow of water passing through the turbine.
 - Control the pressure under which the turbine is working
 - Strengthen the casing of the turbine
 - Reduce the size of the turbine
13. The specific speed (N_s) of a water turbine is expressed by which one of the following equations?
- $$N_s = \frac{N\sqrt{P}}{H^{\frac{3}{4}}}$$
 - $$N_s = \frac{N\sqrt{Q}}{H^{\frac{5}{4}}}$$
 - $$N_s = \frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$$
 - $$N_s = \frac{N\sqrt{P}}{H^{\frac{5}{4}}}$$

14. The function of Draft tube in a reaction turbine is:
- To enable the shaft of turbine to be vertical
 - To transform a large part of pressure energy at turbine outlet into kinetic energy
 - To avoid whirl losses at the exit of the runner
 - To transform a large part of kinetic energy at the turbine outlet into pressure energy
15. Which of the following statements is not correct?
- Cavitation forms where the local pressure drops up to the vapour pressure conditions due to increase in local velocity.
 - Cavitation takes place in turbine blades, runners of pumps, spillways where local velocity increases considerably.
 - Cavitation may be prevented by maintaining the ambient pressure relatively higher at probable points of occurrence by raising their levels.
 - Boundaries likely to be affected by cavitation can be protected against pitting by covering it with tough materials like stainless steel or rubber.
16. The specific speed of hydraulic turbine is 40, what is the type of that turbine?
- Single jet Pelton turbine
 - Multiple Pelton turbine
 - Francis turbine
 - Kaplan turbine
17. The speed ratio of a Pelton wheel operating under a head of 900 m is 0.45. What is the peripheral velocity of the turbine wheel?
- 1.4 m
 - 2.1 m
 - 2.8 m
 - 0.7 m
18. If α is the blade angle at the outlet, then the maximum hydraulic efficiency of an ideal impulse turbine is:
- $\frac{1 + \sin \alpha}{2}$
 - $\frac{1 - \cos \alpha}{2}$
 - $\frac{1 - \sin \alpha}{2}$
 - $\frac{1 + \cos \alpha}{2}$
19. In the selection of the turbine by specific speed or head, which one of the following statements is not correct?
- For specific speed 10-35, Kaplan turbines
 - For specific speed 60-300, Francis turbines
 - For head 50-150 m, Francis turbines
 - For head above 300 m, Pelton wheel
20. The overall efficiency for a Pelton wheel lies between
- 0.5 to 0.65
 - 0.65 to 0.75
 - 0.75 to 0.85
 - 0.85 to 0.90



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SECTION "B"

Attempt *ALL* questions.

1. a. Why governing of hydraulic turbine is necessary? Briefly explain the working of an oil pressure governor. [1+3]
b. An inward flow reaction turbine works under a head of 30 m and discharge of $10 \text{ m}^3/\text{s}$. The speed of runner is 300 rpm. At the inlet tip of runner vane, the peripheral velocity of wheel is $0.9\sqrt{2gH}$ and the radial velocity of flow is $0.3\sqrt{2gH}$, where H is the head on the turbine. If the overall efficiency of turbine is 80%, determine [4]
 - i. The power developed in kW.
 - ii. Diameter and width of runner at inlet.

2. a. Explain priming in centrifugal pump? Write about cavitation in reaction turbine. [1+3]
b. A turbine for the following site condition is to be designed. [4]

Head	: 120 m
Power produced	: 5 x 120 MW
Number of turbines	: 5
Head lost due to friction	: 3% of Gross head
Length of the penstock pipe	: 1300 m each.
Overall efficiency	: 0.87
Number of pairs of poles	: 18
Friction factor	: 0.020
Speed ratio (ϕ)	: 0.75

Determine the diameter of the penstock, runner and the type of turbine. (Refer *Chart I* given if necessary)

3. a. Is the work done possible for jet of water striking on a fixed plate? Explain the concept of work done achieved by jet of water striking on a series of vanes. [1+3]
b. The followings are the hydraulic data for three SHP project site. Select the suitable turbine for each site. Take overall efficiency of each site as 80 %. Assume other data if necessary. [4]

Site	Head	Discharge
A	40 m	$0.5 \text{ m}^3/\text{s}$
B	5 m	$5 \text{ m}^3/\text{s}$
C	300 m	$0.2 \text{ m}^3/\text{s}$

4. a. What is the main purpose of using draft tube in reaction turbines? Explain different types of draft tubes. [1+3]
- b. A Jet of water having a velocity of 40 m/s strikes a curved vane, which is moving with a velocity of 20 m/s. The jet makes an angle of 30° with the direction of motion of vane at inlet and leaves at an angle of 90° to the direction of motion of vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock. [5]
5. a. What is the basic difference between turbine and pump from hydrodynamic point of view? What are the different components of reciprocating pump? Explain its working mechanism. [1+3]
- b. Determine the overall efficiency of a Kaplan turbine developing 2850 kW under a head of 5.2 m. It is produced with a draft tube, with its inlet (diameter 3 m) set 1.8 m above tailrace level. A vacuum gauge connected to the draft tube indicates a reading of 5.2 m of water. Assume draft tube efficiency as 75 percent. [4]

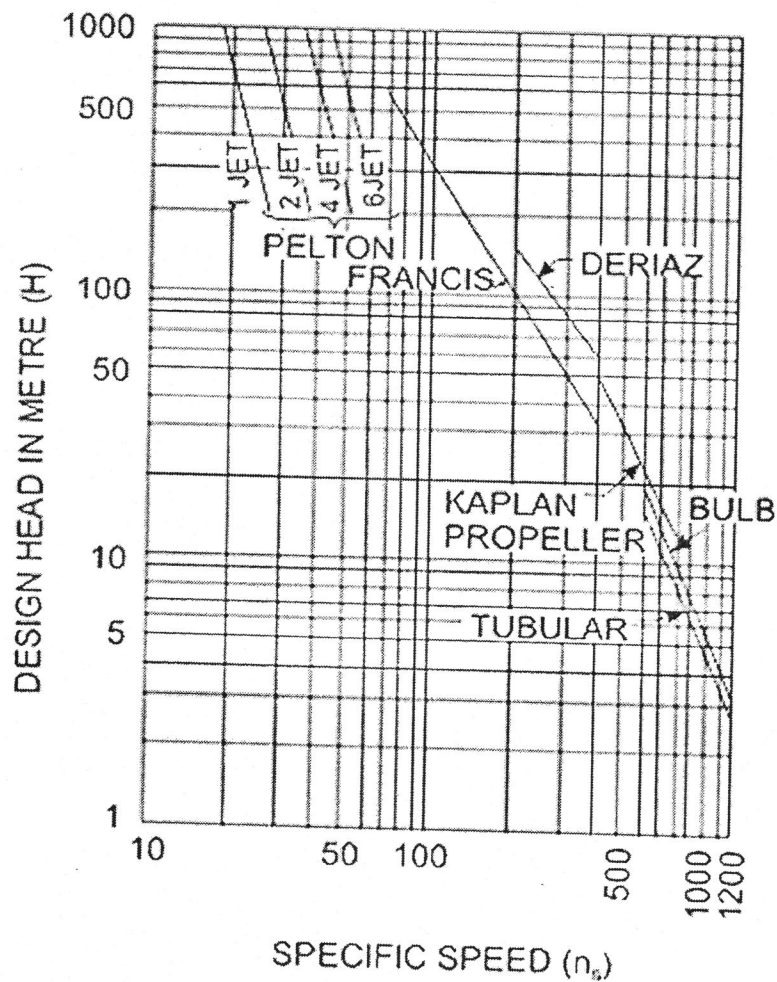


Chart I