

M. E. Power Engineering Examination, 2018

1st yr. 2nd Semester

Subject: Non -Conventional Power Engineering

Time: Three hours

Full marks: 100

Answer any Five questions

1. What do you mean by the dead storage and live storage of a reservoir?
Given below are the monthly rainfall P and the corresponding runoff R values covering a period of 12 months for a catchment. Develop a correlation equation between R and P
- | Month | P | R | Month | P | R |
|-------|----|------|-------|----|-----|
| 1 | 5 | 0.5 | 10 | 30 | 8.0 |
| 2 | 35 | 10.0 | 11 | 10 | 2.3 |
| 3 | 40 | 13.8 | 12 | 8 | 1.6 |
| 4 | 30 | 8.2 | | | |
| 5 | 15 | 3.1 | | | |
| 6 | 10 | 3.2 | | | |
| 7 | 5 | 0.1 | | | |
| 8 | 31 | 12.0 | | | |
| 9 | 36 | 16.0 | | | |
2. The cost of loss of energy due to friction in the penstock against various diameter at the prevalent rate of sale of energy is given by $C_e = 0.261d^2 - 2.926d + 8.449$ and the total annual maintenance cost of a penstock to various diameter is given by $C_t = 0.073d^2 + 0.309d + 0.025$. Find the optimum diameter of the penstock by graphical method.
3. For testing a SHP, the following are the uncertainties of the measuring instruments:
- | For discharge measurement | |
|---|----------------|
| Uncertainty in velocity measurement with PCM | ±2% |
| Uncertainty in area measurement | ±1.0% |
| Uncertainty in velocity-area integration method | ±2.0% |
| For head measurement of 30m | |
| Uncertainty of ultrasonic level sensors at tailrace | ±0.2% of 15m |
| Uncertainty of gauge pressure transmitter | ±0.075% of 30m |
| Uncertainty in measurement of elevations | ±10mm |
| Uncertainty in velocity head measurement | ±10mm |
| For electrical power measurement | |
| Uncertainty of wattmeter | ±0.2% |
| Uncertainty of CTs | ±0.5% |
| Uncertainty of VTs | ±0.5% |
- Calculate the uncertainty in efficiency measurement.
4. What do you mean by Betz coefficient?
Prove that for a horizontal axis wind turbine maximum available power is 59.3% of the raw kinetic power in the wind. State all the assumptions
5. What are the various losses occur in a wind turbine?
What are the main airfoil design parameters of wind turbine blade?

The following are the measured value in a laboratory test of a small wind turbine of blade length of 0.33m.

Angle of Attack of the turbine blade: 25°

Wind Speed, m/s	RPM of the turbine	Generator output reading	
		Voltage (V)	Current (A)
10	19	7.2	0.013
12	92	3.5	0.005
17	350	13.9	0.026
20	240	9.6	0.019
22	115	9.9	0.02
25	75	8.9	0.018

Draw wind turbine performance curve, such as output power vs. wind speed and output power vs. tip-speed ratio.

6. A reaction turbine works at 450rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area at inlet is 0.4 m^2 . The angles made by absolute and relative velocities at inlet are 20 and 120 respectively with the tangential velocity. Determine the volume flow rate, power developed and the hydraulic efficiency.
What is the function of a surge tank?

16+4

7. The data collected during performance testing of a Full Kaplan turbine based SHP (2x1.25MW) at different loads are tabulated below

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Item/Load	100%
Discharge (cumec)	22.31
Pressure at inlet (kg/cm^2)	0.43
Duration of test (minute)	30
Energy reading (Wh)	52.656
CTR	400A/1A
VTR	3.3kV/110V
TWL (right bank), m	2.858
TWL (left bank), m	2.362
Center line of Penstock (Bench mark): 426.50m above MSL	
Level of pressure transmitter diaphragm: 428.55m above MSL	
Elevation of ULS (left bank): 428.889m above MSL	
Elevation of ULS (Right bank): 429.411m above MSL	
Density of water: 997.0 kg/m^3	
Acceleration due to gravity: 9.781 m/s^2	
Diameter of penstock where pressure transmitter is fitted: 3000mm	

Find the efficiency of the plant.