

**B.E. POWER ENGINEERING THIRD YEAR FIRST SEMESTER EXAM 2025****SUBJECT: HYDRO POWER GENERATION**

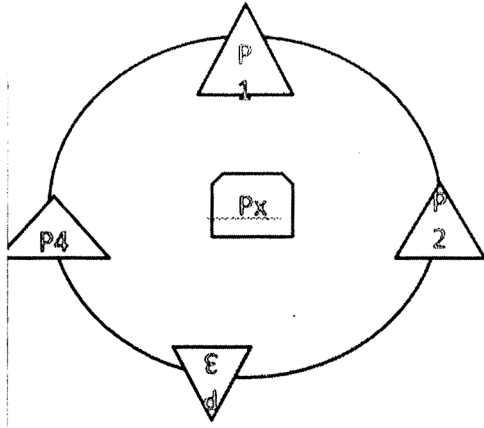
Time -3 hour

Full Marks 100

**(Use separate answer scripts for Part – I and Part – II)****PART-I (70 Marks)**

| Question No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks allotted |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| CO1 1.       | <p>Answer all questions indicating one correct answer against each</p> <p>I) As per BASIN-WISE IDENTIFIED HYDROELECTRIC POTENTIAL REASSESSMENT STUDIES : 1978 - 1987 in INDIA, Highest potential of Hydro Power Generation lies at</p> <ol style="list-style-type: none"> <li>Central Indian, East Flowing and West Flowing rivers combined basins</li> <li>Indus basin</li> <li>Brahmaputra basin</li> <li>Ganga basin</li> </ol> <p>II) Among country wise hydropower share % in overall power generation in Norway and India are</p> <ol style="list-style-type: none"> <li>100 &amp; 50</li> <li>99 &amp; 24</li> <li>95 &amp; 25</li> <li>None of the above</li> </ol> <p>III) In a week of 168 hours, a power utility ideally should run for how many hours to keep system Load factor as 0.60</p> <ol style="list-style-type: none"> <li>100 hours</li> <li>98 hours</li> <li>101 hours</li> <li>99 hours</li> </ol> <p>IV) The mathematic hydrological model is</p> <ol style="list-style-type: none"> <li>RRASS</li> <li>RSARS</li> <li>SSARR</li> <li>SRSRA</li> </ol> <p>V) To predict a 100 year flood in India, generally rainfall records are necessary</p> <ol style="list-style-type: none"> <li>33 to 40 years</li> <li>30 to 50 years</li> <li>35 to 45 years</li> <li>40 to 50 years</li> </ol> <p>VI) Hyetograph and Hydrograph are defined as</p> <ol style="list-style-type: none"> <li>Hyetograph indicate variation in the rate of rainfall w.r.t. time, whereas Hydrograph represents discharge (runoff) versus time in a particular point of a stream.</li> <li>Hyetograph indicate time distribution of total runoff at the point of measurement, whereas Hydrograph represents rate of rainfall intensity over a catchment area.</li> <li>Hyetograph shows rainfall distribution over entire catchment area, and Hydrograph is the graphical representation of the same with discharge measurement.</li> <li>Hyetograph is the rainfall assessment of a particular area, whereas Hydrograph is the graphical presentation of rainfall from start to end in the form of bell curve.</li> </ol> | 10X1 = 10      |

|           | <p>VII) Budgetary Support for enabling infrastructure in HEPs are</p> <p>a) Rs.1.25 Cr/MW for projects upto 200 MW, 1.00 Cr/MW for projects above 200 MW, SHPs upto 25 MW FULL infrastructure cost.</p> <p>b) SHPs 25.00 Cr, FOR 200 MW 250 Cr, For 1.00 Cr/MW for projects above 200 MW</p> <p>c) Rs.1.5 Crore per MW for projects upto 200 MW, Rs.1.0 Crore per MW for projects beyond 200 MW, and HE projects above 25 MW including pumped storagebudgetary support towards cost of enabling infrastructure.</p> <p>d) Rs.1.0 Crore per MW for projects upto 200 MW, Rs.0.75 Crore per MW for projects beyond 200 MW, and HE projects above 25 MW including pumped storagebudgetary support towards cost of enabling infrastructure.</p> <p>VIII) To determine storage capacity of Reservoir, which curve is used</p> <p>a) Flow-duration curve</p> <p>b) Mass curve</p> <p>c) Unit Hydrograph</p> <p>d) Flood Hydrograph</p> <p>IX) To determine mean precipitation over large area, the most accurate method adopted is</p> <p>a) Isohyetal method</p> <p>b) Thiessen polygon method</p> <p>c) Arithmetic mean method</p> <p>d) Statistical method</p> <p>X) In a hydro power project, reservoir is allowed to be depleted up to:</p> <p>(a) dead storage level</p> <p>(b) minimum drawdown level</p> <p>(c) flood storage level</p> <p>(d) normal reservoir level.</p>                                                                                                                                                                                    |                       |                |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
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| CO1. 2    | <p>Answer either of the Question a) or b)</p> <p>a) i) Describe the methodology for estimation of reservoir capacity. Add a sketch and explain.</p> <p>ii) The following data indicates the flow of a river in a dry year. It is proposed to build a dam at this site, where the losses and other requirements are given. Calculate the required storage.</p> <table><tr><th>Months</th><th>Inflow (M Cum)</th><th>Losses &amp; Other(M CuM)</th><th>Demand (M Cum)</th></tr><tr><td>January</td><td>1500</td><td>1130</td><td>200</td></tr><tr><td>February</td><td>1430</td><td>1135</td><td>220</td></tr><tr><td>March</td><td>1350</td><td>1145</td><td>300</td></tr><tr><td>April</td><td>1280</td><td>1145</td><td>280</td></tr><tr><td>May</td><td>1220</td><td>1260</td><td>300</td></tr><tr><td>June</td><td>1180</td><td>1280</td><td>300</td></tr><tr><td>July</td><td>1350</td><td>1170</td><td>300</td></tr><tr><td>August</td><td>1900</td><td>1140</td><td>300</td></tr><tr><td>September</td><td>2010</td><td>1135</td><td>280</td></tr><tr><td>October</td><td>1520</td><td>1140</td><td>250</td></tr><tr><td>November</td><td>1430</td><td>1145</td><td>220</td></tr><tr><td>December</td><td>1240</td><td>1155</td><td>180</td></tr></table> <p style="text-align: center;"><b>Or,</b></p> <p>b) i) Explain Arithmetic mean method, Thiessen polygon method and Isohyetal method with neat sketches and suitable assumptions to estimate rainfall average over a particular area. State the most advantageous method and reason thereof.</p> | Months                | Inflow (M Cum) | Losses & Other(M CuM) | Demand (M Cum) | January | 1500 | 1130 | 200 | February | 1430 | 1135 | 220 | March | 1350 | 1145 | 300 | April | 1280 | 1145 | 280 | May | 1220 | 1260 | 300 | June | 1180 | 1280 | 300 | July | 1350 | 1170 | 300 | August | 1900 | 1140 | 300 | September | 2010 | 1135 | 280 | October | 1520 | 1140 | 250 | November | 1430 | 1145 | 220 | December | 1240 | 1155 | 180 | <p>5</p> <p>10</p> <p>5+2+8</p> |
| Months    | Inflow (M Cum)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Losses & Other(M CuM) | Demand (M Cum) |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| January   | 1500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1130                  | 200            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| February  | 1430                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1135                  | 220            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| March     | 1350                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1145                  | 300            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| April     | 1280                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1145                  | 280            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| May       | 1220                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1260                  | 300            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| June      | 1180                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1280                  | 300            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| July      | 1350                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1170                  | 300            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| August    | 1900                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1140                  | 300            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| September | 2010                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1135                  | 280            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| October   | 1520                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1140                  | 250            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| November  | 1430                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1145                  | 220            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |
| December  | 1240                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1155                  | 180            |                       |                |         |      |      |     |          |      |      |     |       |      |      |     |       |      |      |     |     |      |      |     |      |      |      |     |      |      |      |     |        |      |      |     |           |      |      |     |         |      |      |     |          |      |      |     |          |      |      |     |                                 |

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|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
|        | <p>Station X failed to report rainfall during a storm. The co-ordinates of four surrounding station are (10,10), (-9,6), (-12, -10) and (5, -12) km respectively. Find missing rainfall at X, if rainfall at the four surrounding station was 70, 90, 68, 60 mm respectively.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |
| C01 3. | <p>Answer all the question parts:</p> <p>I) The runoff data of a river is 240, 200, 100, 300, 250, 150, 700, 500, 350, 275, 125, 325, 280, 400, 375, 390, 320, 140, 130 cumecs. Determine 90% dependable value for power generation in cusec.</p> <p>II) Rainfall of intensity 30 mm/hour was occurring over a watershed area of 100 ha for 8 hours continuously. Measured direct runoff volume in the stream draining into the watershed was found to be 40000 m<sup>3</sup>. Calculate the precipitation not available to this runoff.</p> <p>III) A hydropower station has a gross head of 10 meter. Head loss in Penstock is 0.65 meters. Optimum discharge in cusecs is 365. Calculate power and annual energy generation from the plant. Assume LF as 0.59, efficiency as 0.82, yearly generating hours may be considered as 95% of whole year.</p> <p>IV) Describe SWOT analysis for Hydro Power Projects in detail.</p>                                                                                                                   | 2+2+2+9                   |
| C02 4. | <p>Answer both the question :</p> <p>a) The Runoff data of a river in <b>cusec</b> is 3800, 3900, 3450, 3600, 5900, 5450, 3800, 4100, 4450, 5500, 3750, 4800, 5200, 7500, 7180, 7200, 6700, 6000, 6350. Take 90% dependable value for power generation. The RoR Plant shall operate with the 90% dependable discharge value and shall operate under a nett head of 30m. The efficiency of the plant may be considered as 80% and load factor as 60. Considering the capital cost of the project to the tune of 300 Cr, and annual charges as 15% of the capital cost and 12% of the peak load is the reserve capacity, if the sale cost of unit power to the consumer by the hydropower generation authority @ Rs.3.00/ KWh, find out the Benefit cost ratio, and opine if the Project is viable.</p> <p>b) A penstock 4000 m long and 6 m in diameter has a surge tank 30 m in diameter for a discharge of 1400 cusecs. Friction factor f is 0.022. Normal reservoir level is 600 m. Determine maximum and minimum water levels in the tank.</p> | 10+10                     |
| C02 5. | <p>What is the basic difference between Pondage and Storage ? Describe briefly under which site layouts, pondage is usually adopted. Define pondage factor with a numerical example</p> <p style="text-align: center;"><b>Or</b></p> <p>For design of Canal, what are the three equations involved, State those with all factors involved. For lined canal design, state the famous equation as per IS 4745. Describe Unit Hydrograph method with all considerations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>2+5+3</p> <p>4+1+5</p> |

**B.E. POWER ENGINEERING 3<sup>RD</sup> YEAR 1<sup>ST</sup> SEMESTER EXAM 2025****SUBJECT: HYDRO POWER GENERATION****PART-II ( 30 Marks)**

|       | <b>CO3 (20 Marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Marks</b> |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1 (a) | Classify hydraulic turbine according to the energy at inlet. State major differences among them.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2+2          |
| (b)   | How does power output and torque on the shaft of a Pelton wheel vary with bucket speed ?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4            |
| (c)   | Which turbine gives highest efficiency at part load? How this can be achieved?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2            |
| 2.    | <p>A reaction turbine works at 750 rpm under a head of 70 metres. Its diameter at inlet is 100 cm and the flow area is 0.4 m<sup>2</sup>. The angles made by the absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine (i) the volume flow rate (ii) the hydraulic power developed and (iii) the efficiency. Assume whirl at outlet to be zero.</p> <p style="text-align: center;">OR</p> <p>The following data refers to the runner of a Kaplan turbine, which yields 7350 kW at the turbine shaft: net available head 5.5 m, speed ratio 2.08, flow ratio 0.68 and overall efficiency 60%. Presuming that hub diameter of the wheel is 0.33 times the outside diameter. Determine the runner diameter and its rotational speed.</p> | 10           |
|       | <b>CO4 (10 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |
| 3.(i) | How efficiency of a hydraulic power plant is determined?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2            |
| (ii)  | Describe the methods and instruments required to measure the parameters required to determine the unit efficiency.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6            |
| (iii) | Why thermodynamic method is easier determining efficiency of hydraulic turbine? In which situation this method is used?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2            |