16 A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Micro Hydro Power *(Elective III) (EE78501)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is micro hydro power? Show the major components of micro hydro project in a neat sketch. Define gross head. [8]

   b) Three rain gauges are placed at three locations A, B and C to estimate rainfall in a catchment which recorded following rainfalls data [8]

   Record of Gauge A = 2000 mm/yr
   Record of Gauge B = 2700 mm/yr
   Record of Gauge C = 3000 mm/yr

   If the area for A, B and C count 58, 69 and 15 squares where 1 square = 1 square mm and the scale of map is 1:100,000 (i.e 1mm = 100 meter), calculate

   (i) Total catchment area
   (ii) The average rainfall in the catchment are in mm/year
   (iii) Run off from the catchment are (Assume run off as 50% of the rainfall.)
   (iv) The annual average daily flow in m^3/sec

2. a) Write different types of turbines. Explain about pelton turbine with neat sketch. Which turbines are commonly used in micro hydro projects in Nepal? [10]

   b) Mention different types of drive systems. Describe pulley and belt type drive system with neat sketch. [6]

3. a) What is an alternator? Describe different types of alternators use in micro hydro projects. [8]

   b) A 3 phase 20 kW induction motor rated at 440V (line to line), 50 Hz have been chosen to be used as induction generator. The manufacturer's data sheet shows full load current of 28 and full load power factor of 0.85. Calculate the size and voltage rating of the excitation capacitors to be connected in (i) delta (ii) star [8]

4. a) Describe the commonly used protection systems in micro hydro projects? [8]

   b) Write short notes on: (Any four) [8]

   i) ELC
   ii) IGC
   iii) Lightning Protection
   iv) Earthing System
   v) Modular case circuit breakers (MCCB)
   vi) Under / over voltage trips
   vii) 3 phase star and delta connection

5. a) Which type of tariff systems are commonly used in micro hydro projects of Nepal? What is the major differences between those tariff systems? [8]

b) Two households of a community are using the following appliances each; [8]

i) 5 Watt bulb - 4 nos.
ii) 20 Watt bulb - 3 nos
iii) 45 Watt tube light - 1 no.
iv) 75 Watt TV - 1 no.

One household is paying NRs. 1/Watt/month basis while the other household is paying NRs.5/unit basis. How much should each of them pay per month if they use each appliance for;

i) 5 hours/day
ii) 10 hours/day and
iii) 15 hours /day

Compare the differences in payment (consider 30 days in one month)

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26A TRIBHUVAN UNIVERSITY
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Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Micro Hydro Power *(Elective III) (EE78501)*

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- ✓ *Attempt **All** questions.*
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1. a. Define micro-hydro? What are the advantages of micro-hydro over wind power and solar power? [1+3]

b. What do you mean by compensation flow? What happens if demand exceeds the supply capacity and vice-versa? [1+3]

c. Three rain gauges are placed at three location x, y, and z to estimate rainfall in catchment area and the recorded rainfall are as follows: [8]

Gauge at x rainfall x = 2800 mm/yr
Gauge at y rainfall y = 3500 mm/yr
Gauge at z rainfall z = 3800 mm/yr

If the area for x, y, and z count 60, 72 and 10 squares where 1 square = 1 square mm and the scale of map is 1KM to 10 mm. calculate,

i. The average rainfall in the catchment area in mm/yr.
ii. Total catchment area in mm^2.
iii. Runoff from the catchment area (assume 50% evaporation).
iv. The annual average daily flow in m^3/sec.

2. a. Explain why impulse turbine are popularly used in micro-hydro installation. What are the advantages of ELC over conventional hydro mechanical governor? [4+4]

b. A single phase maximum load of 18 kw at 0.5 pf lagging is to be supplied at 230 V, 50Hz from micro-hydro scheme. Estimate the rating of the synchronous generator and the size and number of the water immersion kettle elements to be used as a ballast load. Also, estimate the water flow rate if the temperature of entering water is 20 ^{0}C and only 30 ^{0}C temperature rise is allowed. The specific heat of water is 4200 J/kg/^{0}C for the temperature range concerned. [8]

3. a. Explain why an induction generator be rated to supply a load of power factor not less than 0.8 lagging? How will u choose whether to supply single-phase or three-phase power supply? [4+4]

b. A 3-ϕ 12 kw IM rated at 380V (1-1), 50Hz have been chosen to be used as induction generator. The manufacturer's data sheet shows the following data

Full load current: 23A
Full load pf : 0.8

Calculate,
The size and voltage rating of excitation capacitor when they are connected in delta and star. [6]

4. a. Draw single line diagram of switchgear used in micro hydro. What are the causes of under voltage and over frequency trip in micro-hydro? [4+4]

b. Mention the coverage and significance of the following operation and maintenance documents with regard to smooth operation of micro hydro. [8]

i) maintenance Schedules
ii) Repair manual
iii) Log Book
iv) Training Manual

5. a. Differentiate between flat tariff and energy tariff? What are the different issues associated with the development of micro hydro in Nepal? [4+4]

b. A feasibility study for a micro-hydro scheme estimates annual revenue of $20000 and annual expenditure of $8000 for 15 years life period. If the startup cost is $120000, find out net present worth and discounted payback period for a discount rate of 12%. CommNet on your result and also find IRR of the scheme. [8]

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Year / Part	IV / II	Time	3 hrs.

Subject: - Micro Hydro Power *(Elective III) (EE78501)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) What are the steps for matching the power supply with demands? How the per unit cost of micro hydro scheme be calculated? How the plant factor be improved for MHP schemes? [8]

   b) Describe the salt dilution method of flow measurement. What are the sources of error and how can they minimized? [8]

2. a) Mention different types of turbines used in hydropower projects. Which type of turbines are most commonly used in micro hydro projects in Nepal and why? [5]

   b) What types of drive system are commonly used in micro hydro projects? When can you use direct coupling type drive system? [3]

   c) You have to design a pelton turbine for a micro hydro site having;

      - The gross head of 90 meters,
      - Turbine flow of 75 to 200 l/s during a year
      - Friction loss in penstock pipe equal to 10% of the gross head

      The turbine is required to deliver mechanical power to the generator such thet the generator speed is 1500 rpm. Taking part flow efficiency also into consideration, recommend

      (i) The number of jets,
      (ii) Diameter of runner and
      (iii)The bucket size [8]

3. a) Discuss the effect of ballart load on Generator sizing. [6]

   b) Discuss why induction generator cannot supply load of power factor less than 0.8 lagging. [4]

   c) A 20 KW, 50Hz, 4 pole, 415 V, 3 phase induction motor draws a current of 4.5 A when supplied at its rated voltage and frequency and run as a motor with no mechanical load. Calculate the excitation capacitance which must be connected in delta to make the generator at approximately its rated voltage when driven at slightly above the rated speed. Also calculate the voltage ratings of the capacitor. [6]

4. a) Describe the protection systems used in a micro hydro projects. [8]

b) Write short notes on: [8]

(i) 3 phase star and delta connection
(ii) ELC
(iii) Switch gear
(iv) Earthing System

5. a) Mention two different tariff systems used in micro hydro projects? Which tariff system will you be implemented in your micro hydro project if you are in decision making position? Why? [8]

b) The feasibility study of a micro hydro project provides the following data.

- Initial Investment: NRs. 12,000,000
- Annual revenue: NRs.2,000,000
- Annual expenditure: NRs.800,000
- Life period: 15 years

If a discount rate is 12% find;

(i) The net present value
(ii) Payback period and
(iii)The internal rate of return of the scheme [8]

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