**Assignment 04 (10 marks)**

*About 1.6 billion people in the world are living in rural areas without access to electricity. It is too costly to provide electricity services to rural communities through conventional means due to remote location & low population density. Micro Hydro Power (MHP) is a proposed alternative option if it is economically viable. MHP has the advantage that it can be setup on small streams and does not require the storage of water by building reservoirs or dams. Water is simply diverted from a river, run through a turbine, and then returned to the same river without any loss. Furthermore, by avoiding the use of fossil fuels for energy, CO2 emissions are reduced. A case study in district Dir (upper) of Khyber Pakhtunkhwa has provided the following data for MHPs over the 25-year project life:*

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Capital Cost | Operation & Maintenance Cost | Benefit |
| 2010 | 396.18 | 0 | 0 |
| 2011 | 0 | 108 | 216 |
| 2012 | 0 | 108 | 216 |
| 2013 | 0 | 108 | 216 |
| 2014 | 0 | 108 | 216 |
| 2015 | 0 | 108 | 216 |
| 2016 | 0 | 108 | 216 |
| 2017 | 0 | 108 | 216 |
| 2018 | 0 | 108 | 216 |
| 2019 | 0 | 108 | 216 |
| 2020 | 0 | 108 | 216 |
| 2021 | 0 | 121 | 233 |
| 2022 | 0 | 121 | 233 |
| 2023 | 0 | 121 | 233 |
| 2024 | 0 | 121 | 233 |
| 2025 | 0 | 121 | 233 |
| 2026 | 0 | 121 | 233 |
| 2027 | 0 | 121 | 233 |
| 2028 | 0 | 121 | 233 |
| 2029 | 0 | 121 | 233 |
| 2030 | 0 | 121 | 233 |
| 2031 | 0 | 121 | 233 |
| 2032 | 0 | 121 | 233 |
| 2033 | 0 | 121 | 233 |
| 2034 | 0 | 121 | 233 |
| 2035 | 0 | 121 | 233 |

. Note: All cell values are in ‘000 of Pakistani rupees (PKR)

**Note**: You may use MS Excel if needed. Make sure you include the excel file contents at the end of you’re the Word document containing your answers if you use Excel for any working.

1. Calculate net benefit for each year [1 mark if all calculations are correct]
2. Calculate the overall Net Present Value of the project using a 12% discount rate [2.5 marks total: 2 for formula and working, 0.5 for answer]
3. For how many years does the MHP project have negative total net present value? [0.5 mark]
4. Is the project viable overall? Explain [1.5 marks total: 0.5 for answer, 1 for explanation]

*Without access to national electricity grid, the local population relies on diesel generators. Not only is the diesel fuel costly, but it also causes Green House Gas (GHG) emissions.*

1. Should savings in the cost of diesel fuel be included as part of the MHP net benefits? Explain [1.5 marks total:0.5 for answer and 1 for explanation]

*The total installed capacity of the MHP is 1060 kWh (kilo Watt hours) and the project runs for 11 hours a day on average. This energy supplied through fossil fuels would produce 1.4kg of CO2 equivalent of GHG emissions for each kWh of energy.*

1. Find the total annual GHG emissions reduced by the MHP [1.5 marks total: 0.5 for answer, 1 for working]

*Pakistan ratified the Kyoto Protocol in January 2005, making it eligible for financial benefits through selling Certified Emission Benefits (CERs). Projects such as the MHP can provide clean and affordable energy to rural areas while also earning revenues for the country. If the price of one thousand kg of CO2 equivalent of GHG emissions is US $23.*

1. How much can the MHP earn per annum? [1.5 marks total: 0.5 for answer, 1 for working]