16A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Electric Energy System Management *(Elective I) (EE72501)*

- ✓ 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 are the goals of Nepal Hydropower Development Policy, 2001? Mention how this policy has encouraged private/public investment in power section. [5]
   b) What do you mean by power system restructuring? State the various models of restructuring with neat diagram. [6]
   c) Write a short note on 'Foreign investor owned Utility Nepal'. [5]
2. a) Differentiate between cash basis and accrual basis of accounting principles. [5]
   b) Shikhar Hydropower Company brought a turbine for NRs. 10,00,000. It is expected that turbine should have a residual value of NRs. 120 thousand. Entity uses declining balance method of depreciation and depreciates at 20% every year. Give a schedule showing depreciation of assets for 5 years. [6]
   c) Write about the public finance as a source of project funding. [5]
3. a) Write briefly about the long range, medium range and short range forecasting with their characteristics, applications and methods. [4]
   b) The annual maximum demands for a power company for the last five years are given below. Find out the best fitting model out of exponential and parabolic mathematical models based on MAPE. Using the best fitting model, forecast the annual energy demand for the next three years. Assuming the constant load factor of 0.7 for all, take first 3 data as the initialization set. [8]

Year	2012	2013	2014	2015	2016
Max.Demand, MW	200	230	250	290	300

   c) Write the circumstances of uncertainties in load forecasting. [4]
4. a) What are the constraints to system security? Explain briefly. [4]
   b) Write a short note on 'Bath tub curve in context of reliability'. [4]
   c) Considering a system consisting of three generating units having capacities of 450MW, 500MW and 750MW with corresponding forced outage rates of 0.01, 0.03 and 0.04, find the loss of load probability (LOLP) of yearly triangular load duration curve which has a peak load of 1200MW and base load of 200MW. [8]
5. a) Write briefly about the priority list, unit commitment scheme and unit commitment schedule for the economic load dispatch. [6]
   b) The fuel input per hour of plants 1 and 2 are given below: [6]

$$F_1 = 0.2p_1^2 + 40p_1 + 120 \text{Rs/hr}$$

$$F_2 = 0.3p_2^2 + 30p_2 + 200 \text{Rs/hr}$$

   c) Determine the optimum operating schedule and the corresponding cost of generation to meet a demand of 180MW, if the maximum and the minimum loading of each unit are 100MW and 25MW respectively. Neglect the transmission losses. [10]

16 A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Electrical Energy System Management *(Elective I) (EE72501)*

- ✓ 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) Highlight the roles of different government institutions involved in the power sector development. [10]

   b) How do you evaluate the 9th periodic plan in terms of power generation in the country? [6]

2. a) Differentiate between accrual basis of accounting and cash basis of accounting. Explain the realization concept and matching concept of accrual based accounting with example. [8]

   b) A 6.6 /33 KV, 10 MVA transformer was purchased before 9 years at a cost of NRs.1 crore. The useful life of the transformer is assumed to be 30 years. Salvage value of the transformer at the end of its useful life is NRs.2 lakh. Calculate the depreciated value at present using

   (i) Straight line method
   (ii) Fixed percentage on a declining balance method if fixed percentage charge on the book value is 7%
   (iii) Sum of the years digit method. [8]

3. a) Explain why and how the method of load survey is used for electrical load forecasting. [6]

   b) Give reason why the system is treated as a black box in time series approach of load forecasting. The past load data of an electric utility for the past eight years are given below. Find out the best fitting model out of exponential and parabolic mathematical models based on their Mean Absolute Percentage Error (MAPE) and forecast the peak loads for another eight years using the best fitting model. Take first 5 data as the initialization set. [10]

Year	2009	2010	2011	2012	2013	2014	2015	2016
Peak load, MW	200	220	250	285	300	340	380	425

4. a) Discuss the security constraint in the power system. [8]

b) A utility has following data on 33 KV oil filled CT. Assume the CT to be non repairable.

Nos. Installed	Installed yr.	Nos. failed	Failure yr
16	1990	1	1999
		2	2005
		3	2007
		1	2008
		3	2009
		2	2011
12	1995	1	2006
		1	2008
		2	2009
		1	2010
		2	2011

Calculate MTTF and constant hazard rate. Also obtain the Reliability function, Unreliability function and Unreliability density function. [8]

5. a) Discuss the penalty factor while carrying out power transactions between the different utilities. Mention the operational problems in economic load dispatch. [8]

b) Prepare the priority list and unit commitment scheme and prepare the commitment schedule for the following four thermal units to meet the loads as per the given load curve. Take spinning reserve equal to 15% of the load being served. [8]

Unit	Fuel cost (TRs/Btu)	Output power(MW)		I/O characteristics (H in MBtu/hr)
		Min.	Max.	
1	1.3	150	600	H1=510+7.2P1+0.00142P12
2	1.0	100	400	H2=310+7.85P2+0.00194P22
3	1.4	50	200	H3=78+7.97P3+0.0048P32
4	1	75	500	H4=250+7.5 P4+0.0026P42

Load curve data: 0-5 hrs: 80 MW, 5-7 hrs: 150 MW, 7-10 hrs: 370 MW, 10-11 hrs: 600 MW, 11-13:950 MW, 13-17 hrs: 1100 MW, 17-22 hrs: 350 MW, 22-24 hrs: 50 MW

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17A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Electrical Energy System Management *(Elective I) (EE72501)*

- ✓ 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) Give reason for the growth of independent power producers after restoration of democracy in 1990. [6]

   b) What is power sector restructuring? What are the major models of restructuring? Considering current scenario suggest appropriate model for Nepal. [3+3+4]

2. a) Classify the accounts on the basis of accounting equation? Differentiate between cash basis and accrual basis of accounting with appropriate examples. [8]

   b) A utility company wants to buy a 3 phase 500 KVA, 33/11 KV transformer for its substation which will come in operation at the end of this year. One company asks $10,000 in cash one year from now to deliver the transformer at the end of this year. Another company offers the transformer of the same size today (now) at the price of $9500. Which offer should be accepted? Interest rate is 10%. [8]

3. a) Stating the necessary assumptions, discuss the extrapolation method of load forecasting? [6]

   b) Following is the annual peak demand data for a utility for the last 14 years. Using the best fitting model, forecast the annual peak demand for next 20 years for utility based on MAPE. Take first 9 data as the initialization set. [10]

Year	1999	2000	01	02	03	04	05	06	07	08	09	10	11	12
Max. Demand MW	252	256	267	281	278	279	282	286	289	293	317	327	335	340

4. a) Explain how different kinds of reserves are managed to maintain system security. [6]

   b) Find the loss of load probability (LOLP) index for one-month duration if the load during the first, second, third and forth weeks is 400 MW, 650 MW, 150 MW and 300 MW respectively. The capacity and outage rate are given in table below. [10]

Unit	Capacity MW	FOR
1	250	0.015
2	325	0.025
3	450	0.02

5. a) Two generating units of a power system are having for the following cost curves: [8]

   $F1 = 0.05P_1^2 + 22P_1 + 120$ thousand Rs/hr

   $F2 = 0.06P_2^2 + 16P_2 + 120$ thousand Rs/hr

   P1, P2 are in MW. Maximum and minimum generation of each unit are 100 MW and 20 M and 90 and 30 MW respectively. Determine the optimum operating and the corresponding cost of generation to meet a demand of 80MW, neglecting the transmission lines losses.

   b) What is coordination equation? Explain with derivation. What is the use of penalty factor when considering power transaction between two different electric utilities [4+4]

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14A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Electrical Energy System Management *(Elective I) (EE72501)*

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

1. a) List out the priorities for hydropower development in Nepal considering current electricity demand supply scenario. [6]

   b) Give the whole sale and retail competition models in context of power system restructuring and mention the characteristics of each of them. [10]

2. a) Describe the funding and operating principles of an electric utility. [8]

   b) Discuss the Sum of the year's digits method of calculating asset's depreciation. A 10 kW diesel generating scheme is proposed for electrifying a small village which has a start up cost of NRs 2000000. A financial forecast showed that the electrification scheme will bring an annual earning of NRs. 500000. The operation and maintenance costs are expected to be NRs. 100000 per year. If the project's life is assumed to be 12 years, decide whether the scheme is a viable proposition based on the net annual income. Take a discount rate of 12%. [8]

3. a) The annual maximum demands for a certain utility for the last nine years are given below. Find out the best fitting model out of linear and exponential mathematical models based on their Mean Absolute Percentage Error (MAPE). Using the best fitting model, forecast the annual maximum demand for the next 10 years. Take first 6 data as the initialization set. [10]

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Maximum demand, MW	146	160	180	200	240	255	280	298	325

   b) What are the tools and approaches applied in load forecasting? What are the errors and uncertainties of load forecasting? [3+3]

4. a) Explain the bath tub curve of reliability. The unit capacity and outage data for three units are given below. Find the loss of load probability (LOLP) index for one year duration-if the load during first quarter is 500 MW, during the second quarter is 700 MW, during the third quarter is 150 MW and during the last quarter is 300 MW. [4+6]

Unit	Capacity, MW	FOR
1	250	0.015
2	325	0.02
3	450	0.025

   b) What are the constraints to system security? Explain briefly. [6]

5. a) Prepare the priority list, unit commitment scheme and unit commitment schedule for the following four thermal units to meet the load as per the given load curve. Take spinning reserve equal to 10% of the load being served. The load curve data are: 0-5 hrs:80 MW, 5-7 hrs:150 MW, 7-10 hrs:370 MW, 9-12 hrs:600 MW. [10]

Unit	Fuel cost (₹Rs/MBtu)	Output power, MW		I/O characteristics (H in MBtu/hr)
		Min.	Max.	
1	60	150	600	$H_1=500+7P_1+0.0015P_1^2$
2	55	100	400	$H_2=300+8P_2+0.0025P_2^2$
3	55	50	200	$H_3=100+7.5P_3+0.005P_3^2$
4	53	75	500	$H_4=250+7.5\ P_4+0.0026P_4^2$

b) Find the optimum economic operating point for above units to meet a load 600 MW without considering the network losses. [6]

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14A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

Subject: - Electrical Energy System Management *(Elective I) (EE72501)*

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

1. a) With neat arrow diagrams and highlighting the major characteristics, discuss the Purchasing Agency model of power system restructing. [8]
   b) Highlight the private sector friendly provisions offered by Electricity Act 2049 that attracted IPPs to invest in hydropower development. [4]
   c) What is the role of Water and Energy Commission Seretariat (WECS) in power sector development? [4]
2. a) Discuss the various types of capital formation for a business by a limited company. [8]
   b) Showing a typical cash flow diagram, with example, explain how profitability index is used for decision making for investment project. [4]
   c) Distinguish between accounting and engineering perspective of depreciation. How the asset is depreciated using Sum of the year's Digits method. [2+2]
3. a) What are the pre-requisites and assumptions for using mathematical methods of forecasting? [2]
   b) Classify the load forecasting based on during of future period. [2]
   c) Using the following maximum demands for the past 11 years for a utility forecast the maximum demands for the next 8 years for the same utility. Use the best fitting model out of linear, exponential and parabolic mathematical models on the basis of Mean Absolute Percentage Error (MAPE) for forecasting. Take first 8 data as the initialization set. [12]

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Maximum demand, MW	470	525	858	650	745	830	900	970	1055	1120	1200

4. a) What are reserves? How are reserves classified? [2+2]
   b) Describe the concept of 'bathtub curve' as applied in power system security. [4]
   c) Find the loss of load probability (LOLP) for the following three units which supply power to Kathmandu and Pokhara: [8]

Unit	Capacity, MW	FOR
Kaligandaki-A	144	0.015
Madyamarsyangdi	70	0.02
Lower Marsyangdi	69	0.025

The data for load duration curve are:
15% of time in a year: 400 MW, 25% of time in a year: 500 MW, 30% of time in a year: 250 MW and Remaining 30 % of time in a year: 150 MW

5. a) Discuss the use of penalty factor while carrying out power transactions between the different utilities. [4]

b) Using coordination equation and the loss formula, carry out two iterations to find the optimum dispatch to meet a total demand of 190 MW for the following three units: [12]

Unit	Output power, MW		I/O characteristics (H in MBtu/hr)
	Min.	Max.	
1	50	250	$H_1=312.5+8.25P_1+0.005P_1^2$
2	5	150	$H_2=112.5+8.25P_2+0.005P_2^2$
3	5	100	$H_3=50+8.25P_3+0.005P_3^2$

The loss coefficient matrix is:

$$B_{ij}=\begin{bmatrix} 1.36\times10^{-4} & 1.75\times10^{-5} & 1.83\times10^{-4} \\ 1.75\times10^{-5} & 1.54\times10^{-4} & 2.82\times10^{-4} \\ 1.83\times10^{-4} & 2.82\times10^{-4} & 1.61\times10^{-4} \end{bmatrix}$$

Assume fuel cost for all units =1.831US$ per MBTU. Start from P1=100 MW, P2=40 MW and P3=50 MW.

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TRIBHUVAN UNIVERSITY 4/17
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Electrical Engineering System Management *(EE72501) (Elective I)*

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

1. a) Mention the characteristics of wholesale and retail competition models for power system restructuring with their respective flow diagrams. [3+3]
   b) What is the level of power sector restructuring existing in Nepal? What are future possibilities? [6]
   c) How is the use water resources prioritized as per the Water Resources Act, 2049? [4]
2. a) Discuss the debit-credit concept on the basis of accounting identity. How are accounts classified based on accounting equations? [7]
   b) A PV solar system is installed at an initial cost of NRs 1000000/-. It is estimated that the system will last for 25 years period and will have a salvage value of NRs 50000/- by the time. Calculate the depreciated value of the system after 10 years period? [5]
   c) What are electric utility funding requirements? How are those requirements fulfilled? [4]
3. a) What are the objectives of load forecasting? Classify load forecasting. [4]
   b) Discuss the errors and uncertainties in the process of load forecasting. [4]
   c) The annual maximum demands for a certain utility for the last eight years are given below. Find out the best fitting model out of linear, exponential and parabolic mathematical models based on their Mean Absolute Percentage Error (MAPE). Using the best fitting model, forecast the annual energy demand for the next 10 years assuming a constant load factor of 0.65 for all the past eight years. Take first 5 data as the initialization set. [8]

Year	2005	2006	2007	2008	2009	2010	2011	2012
Max. Demand MW	200	231	244	272	278	284	298	312

4. a) Explain, with underlying assumption, the concept of loss of load probability. [3]
   b) Explain bath tub curve in context of reliability. [5]
   c) A utility has following data in 33 KV oil filed CT. Assume CT to be non-repairable type. [8]

Installed NOS #	Installed year	NOS.failed	Failure year
20	1995	1	1995
		2	1998
		1	2000
		3	2002
		2	2005
10	2002	1	2002
		2	2004
		2	2006

Calculate : (a) Average MTTF in year
(b) Constant hazaid rate, λ in per year
(c) Reliability function
(d) Unreliability function
(e) Reliability density function

5. a) Discuss the effect of not considering the reactive power in economic load dispatch problems and suggest ways to minimize the same. [4]

b) What is penalty factors and why is it named so? How is it used in the power transation between the two areas? [5]

c) The fuel input per hour of plants 1 and 2 are given as, [7]

$$F_1 = 0.2p_1^2 + 40p_1 + 120 \text{ rs/hr}$$

$$F_2 = 0.25p_2^2 + 30p_1 + 150 \text{ rs/hr}$$

Determine the optimum operating schedule and the corresponding cost of generation to meet a demand of 180 M/W if the maximum and minimum loading of each units are 100 MW and 25 MW respectively. Neglect the transmissing losses.

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17A TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2070 Chaitra

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

Subject: - Electrical Engineering System Management *(Elective I) (EE72501)*

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

1. a) What is the purpose of inviting foreign investors to participate in the power sector? Highlight the general features of foreign investor owned utilities. [2+5]

   b) Discuss the growth of independent power producers after restoration of democracy in 1990. [4]

   c) Briefly explain the organizational structure of the largest electricity utility in Nepal. [5]

2. a) Give the traditional classification of accounts? Mention the debit credit rule for these accounts. [3+2]

   b) A utility company wants to buy a 500 KVA, 33/11 KV transformer for its substation which will come in operation at the end of this year. One manufacturing company asks $20,000 in cash one year from today, saying that it will deliver the transformer at the end of this year. Another company offers the transformer of the same size today at a price is $ 19,000. Which offer will be accepted? Interest rate is 10%. [6]

   c) Define depreciation from accounting and engineering perspective. Which one is prevailing in our accounting system and why? How the asset is depreciated using declined balance method? [2+1+2]

3. a) Stating the conditions under which averaging methods are used, explain how future data are forecasted using these methods. Also mention their characteristics. [6]

   b) The annual peak demand data for a certain utility is given below for 10 years. Find out the best fitting model out of linear, exponential and parabolic models based on their mean Absolute percentage error (MAPE). Using the best fitting model, forecast the annual maximum demand for next 15 years. Take first 6 data as the initialization set. [10]

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Max. Demand (Mw)	141	150	146	204	216	214	231	244	275	278

4. a) What are the elements of a constrained optimization problem? Explain a tool to solve optimization problem. [8]

   b) Considering a system consisting of three generating units having capacities of 260 MW, 330 MW and 460 MW with corresponding forced outage rates of 0.01, 0.02 and 0.03, find the loss of load probability (LOLP) for yearly triangular load duration curve which has apeak load of 700 MW and base load of 150 MW. [8]

5. a) Considering that the increment in load is taken care by only one unit, give the physical interpretation of penalty factor. [8]

   b) Determine the economic operating point for the following three units. Neglect the transmission losses. The total demand to be met is 850 MW. [8]

Unit I/O Characteristics (H in Mbtu/hr)	Minimum MW	Maximum MW	Fuel cost TRs/Mbtu
$H_1=510+7.2P_1+0.00142P_1^2$	150	600	49.0
$H_2=310+7.85P_2+0.00194P_2^2$	100	400	55.0
$H_3=78+7.97P_3+0.00482P_3^2$	50	200	55.0

1 TRs= Rs. 1000.

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27A TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

Subject: - Electrical Engineering System Management *(Elective I)*

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

1. (a). Give the various power system restructuring models and mention the characteristics of each of them. Which model best fits in Nepalese power system? [12]

   (b). What are the differences between a private utility and a public utility? [4]

2. (a). Explain the meaning of simple and discounted pay-back period with an appropriate example. [5]

   (b). A bio gas plant has been estimated at an initial cost of NRs 2000000 for a group of consumers. It has also been estimated that the plant will bring an annual earning of NRs 300000. The operation and maintenance costs are expected to be 3% of the initial cost per year. If the installation is assumed to last for 15 years, decide whether it is good to invest in the plant with a discount rate of 10%. Give your decision on the basis of net annual income. [4]

   (c) Explain the meaning of depreciation from engineering and accounting perspective. Explain any two methods of calculating depreciation of assets in a project. [7]

3. (a) State the objectives of electrical load forecasting. [4]

   (b). Discuss the errors and uncertainties in the process of load forecasting. [4]

   (c) The annual maximum demands for a certain utility for the last eight years are given below. Find out the best fitting model out of linear, exponential and parabolic mathematical models based on their Mean Absolute Percentage Error (MAPE). Using the best fitting model, forecast the annual energy demand for the next 10 years assuming a constant load factor of 0.65 for all the past eight years. Take first 5 data as the initialization set. [8]

Year	2005	2006	2007	2008	2009	2010	2011	2012
Max. Demand, MW	200	231	244	272	278	284	298	312

4. (a) Explain, with underlying assumption, the concept of loss of load probability. [3]

   (b) Explain bath tub curve in context of reliability [5]

   (c) Find the loss of load probability (LOLP) for the following proposed hydro units: [8]

Unit	Capacity,MW	FOR
Tamor	100	0.015
Dudhkoshi	350	0.03
Upper Tamakoshi	456	0.025

The data for load duration curve are:

20 % of the time in a years: 550 MW, 30% of the time in a year :750 MW, 35% of time in a years: 230 MW, 15% of time in a years 250 MW

5. (a) Considering that the increment in load is taken care by only one unit, give the physical interpretation of penalty factor. [8]

(b) Determine the economic operating point for the following three units. Neglect the transmission losses. The total demand to be met is 850 MW. [8]

Unit I/O Characteristics (H in Mbtu/hr)	Minimum MW	Maximum MW	Fuel cost TRs/Mbtu
$H_1=510+7.2P_1+0.00142P_1^2$	150	600	49.0
$H_2=310+7.85P_2+0.00194P_2^2$	100	400	55.0
$H_3=78+7.97P_3+0.00482P_3^2$	50	200	55.0

1 TRs= Rs. 1000.

6. Write short notes in any three of the following [16]

(a) Growth of private sector in Nepalese power sector
(b) Decision criteria for investment alternatives
(c) Load forecasting by extrapolation method
(d) Repairable and non- repairable items

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1B TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Electrical Energy System Management *(Elective I) (EE72501)*

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

1(a). Mention the roles of Ministry of Energy (MoEn) and Nepal Electricity Authority (NEA) in power sector development. [4]

(b). What is meant by power system restructuring? Highlight its goals, constraints and pre-requisites. [6]

(c) What are the objectives of hydropower development policy 2001. .Mention the provision on PPA as per this policy. [6]

2(a). Discuss any two methods of calculating assets depreciation. [5]

(b) A PV solar system is planned for a group of consumers at an initial cost of NRs 1600000. Financial estimate shows that the system will bring an annual earning of NRs 400000. The operation and maintenance costs are expected to be 4% of the initial cost per year. If the installation is assumed to last for 12 years, would it be worth investing for the system with a discount rate of 12%? Make your decision on the basis of net annual income. [5]

(c) Explain the meaning of internal rate of return, simple pay back and discounted payback in context of investment decision. [6]

3(a). What are the possible errors and uncertainties in load forecasting? [4]

(b) The annual maximum demands for a certain utility for the last nine years are given below. Find out the best fitting model out of linear, exponential and parabolic mathematical models based on their Mean Absolute Percentage Error (MAPE). Using the best fitting model, forecast the annual maximum demand for the next 12 years. Take first 6 data as the initialization set. [12]

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Maximum demand, MW	73	76	79	83	86	88	89	95	106

4.(a) Explain about the following constraints to system security
i) :Network constraint ii) design limitation [4]

(b) How does reliability differ from quality? [3]

(c) The unit capacity and outage data for three units are given below. Find the loss of load probability (LOLP) index for one month duration if the load during first week is 500 MW, during the second week is 700 MW, during the third week is 150 MW and during the last week is 300 MW. [9]

Unit	Capacity, MW	FOR
1	250	0.015
2	325	0.02
3	450	0.025

5(a) Derive coordination equation and define penalty factor. how is penalty factor used in power transactions?. [8]

(b). Prepare the priority list and unit commitment schedule for the following three thermal units to meet the load as per the given load curve. Take spinning reserve equal to 15% of the load being served.
The load curve data are: 0-10 hrs: 90 MW, 10-18 hrs: 590 MW, 18-24 hrs: 950 MW [8]

Unit	Fuel cost (TRs/MBtu)	Output power, MW		I/O characteristics (H in MBtu/hr)
		Min.	Max.	
1	60	150	600	$H_1=500+7P_1+0.0015P_1^2$
2	55	100	400	$H_2=300+8P_2+0.0025P_2^2$
3	53	75	500	$H_4=250+7.5P_4+0.0026P_4^2$

6. Write short notes on any three of the following: [16]
(a) Private sector participation in hydro power development
(b) Bath tub curve
(c) Operational problems in economic load dispatch
(d) Approaches to load forecasting

05B TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Electric Energy System Management *(EG735EE) (Elective)*

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

1. Discuss the provisions made in the hydropower development policy 2001 with regard to the following: (i) License (ii) Investment (iii) Power purchase (iv) Royalty. [12]
2. A proposed hydro scheme has a capital cost of $ 6000. An annual revenue of $ 18000 is expected. If the expenditure per year is $ 4000, calculate: (i) Simple pay back period (ii) Discounted pay back period. [8]
3. The annual peak demand data of a utility are listed below:

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
Peak demand	7.9	8.3	8.6	8.8	8.9	9.5	9.9	10.6	11.2

Find out the best fitting model out of linear and exponential mathematical models based on their Mean Absolute Percentage Error (MAPE). Using the best fitting model, forecast the annual peak demand for next 10 years for the utility. Take first 6 data as the initialization set. [16]

4. Carry out two iterations to determine the economic operating point for the following three thermal units when delivering a total load of 1000MW. Assume a simplified transmission loss formula $PL = 0.00003\ P_1^2 + 0.00009P_2^2 + 0.00012P_3^2$. [16]

Unit I/O characteristics (H in Mbtu/hr)	Min MW	Maximum MW	Fuel cost ($ Mbtu)
$H_1 = 500+7P_1 + 0.0015P_1^2$	200	600	750
$H_2 = 300+8P_2 + 0.0025P_2^2$	50	300	685
$H_3 = 100+7.5P_3 + 0.005P_3^2$	100	500	625

5. a) Define power system security. [4]
   b) Why should the running spare capacity be located geographically throughout the system? How is the running spare capacity provided in power system? [6]
6. What is meant by forced outage rate? Prove that the forced outage rate of a component service is equal to its unavailability. [8]
7. Write short notes on: (any two): [5+5]
   a) Power system reliability and its properties
   b) Classification of power utilities
   c) Unit commitment.

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