

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination

Summer Semester, A. Y. 2022-2023

Course No.: EEE 4635/ EEE 4699

Time: 90 Minutes

Course Title: Power System Operation and Control

Full Marks: 75

There are 3 (three) questions. Answer all of them. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

1. a) Explain the following terms with examples: 09
 i) Minimum down time, ii) Crew constraints, iii) Cold-start cost (CO1, PO1)

- b) For a three-unit system the following data is given: 16
(CO3, PO2)

P_{Gmin} (MW)	P_{Gmax} (MW)	Heat Rate (MBtu/h)	Fuel Cost (\$/MBtu)
150	600	$510+7.2P_G+0.00142P_G^2$	1.1
100	400	$310+7.85P_G+0.00194P_G^2$	1.0
50	200	$78+7.97P_G+0.00482P_G^2$	1.2

If the demand is 800 MW and a maximum of two units are allowed to run at a time due to crew constraints, determine the most economic unit combination.

2. a) Describe the necessity and rules of keeping spinning reserve in a power system. 05
(CO1, PO1)
- b) An interconnected power system has the following set of data: 20
(CO3, PO2)

Region	Units	Unit Capacity (MW)	Unit Output (MW)	Regional Load (MW)
1	1	1000	800	1700
	2	800	600	
2	3	1200	1100	1300
	4	700	500	

The maximum transfer capacity of the interconnector is 550 MW. Find out the cases where the outage of a single unit should overload the interconnector.

3. A three-unit system data is given below: 25
(CO3, PO2)

Unit No.	P_{max} (MW)	P_{min} (MW)	Inc. Heat Rate (BTU/kWh)	No Load Cost (\$/h)	Fuel Cost (\$/MBTU)
1	80	25	10000	200	2.0
2	250	60	9000	550	
3	300	75	8000	670	

Unit No.	Initial Status	Start-up Costs (\$)
1	ON	150
2	OFF	170
3	ON	500

The load pattern for a two-hour operation is given below:

Hour	Load (MW)
1	450
2	330

Consider a simplified cost characteristics for the units as $F(P) = \text{No-load cost} + \text{Incremental cost} \times P$. Follow enumeration scheme, ignore minimum up time and minimum down time constraints, and adopt dynamic programming approach to find the most economic unit combinations for the given load pattern.