Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: B.Tech Electrical and PSE **Semester: V**
Programme: Nuclear and Hydro Power Plant (ELEG 349) **Time: 03 hrs.**
Max. Marks: 100
Instructions:

SECTION A

		Marks	CO
Q 1	"Power of a nuclear reactor is $4.8*10^{-12}$ mnC watt". Describe on which factors the statement is true.	**4**	**CO1**
Q 2	Explain how do the losses in the draft tube affect the pressure at runner exit and setting of the runner above tailrace level.	**4**	**CO3**
Q 3	A 200 MW of average electrical power is required for a city. If this is to be supplied by a nuclear reactor of 0.20 efficiency, using U^{235} as the nuclear fuel, calculate the amount of fuel required for one-day operation. Assume that energy released per fission of U^{235} nuclide=200 MeV.	**4**	**CO2**
Q 4	The quantity of water available for hydro plant is $250 m^3$/sec under a head of 1.6 m. If the speed of the turbine is 50 r.p.m. and efficiency is 82% determine the number of units required. Assume N_s==740.	**4**	**CO4**
Q 5	Define the following terms: Critical size Core, Mass curve, Radioactivity and reproduction factor.	**4**	**CO5**

SECTION B

Q 6	When a run of river plant operates as a peak load station with a weekly load factor of 15%, all its capacity is firm capacity. What must be the minimum flow in the river so that the station may serve as the base load station? Data given as: Rated Capacity: 5,000 kW with operating head-15 m, efficiency of a plant is 85%. Estimate the daily load factor of the plant if the stream flow is 10 cumsec.	**10**	**CO4**
Q 7	a) Explain the significance of half-life, mean life, decay constant and binding energy. b) Find the U^{235} fuel used in one year in a 250 MW PWR. Assume an overall plant efficiency of 30% and 100% load factor throughout the year.	**5+5**	**CO5**
Q 8	Define the term Specific Speed. Also, find out the expression for the specific speed of a water turbine in terms of power developed, speed and head available.	**10**	**CO1**
Q 9	Distinguish between breeder and converter reactor. Derive an expression for maximum conversion of fertile material in a converter reactor. The half-life of radon gas is 3.83 days. What is its radioactive decay constant? What percentage of the radon atoms originally present will decay in a period of 45 days?	**10**	**CO2, 5**

<table>
<tr><td></td><td>OR
Define the term amu with their significance in nuclear physics. Also, derive the expression that shows the relationship between mass and energy. Find the average binding energy per nucleon for heavy hydrogen ($_1H^2$).</td><td></td><td></td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>a) Draw the schematic diagram of indirect cycle reactor of the nuclear power plant.
b) A proposed hydro-electric station has an available head of 120 meters, a catchment area of 200 sq. km, the rainfall of which is 120 cm per annum. If 0.62 of the total rainfall can be collected, then calculate the power that could be generated. Suggest suitable rating of generator.</td><td>10+10</td><td>CO1, 5</td></tr>
<tr><td>Q 11</td><td>A load required by the consumers from the power plant for 24 hrs. is tabulated as given below:
<table><tr><td>Time</td><td>6 A.M.-10A.M</td><td>10 A.M.-6 P.M</td><td>6 P.M.-12 P.M</td><td>12 P.M.-6 A.M</td></tr><tr><td>Load(MW)</td><td>60</td><td>120</td><td>40</td><td>10</td></tr></table>a) Find the net revenue earned if the load is taken by a single thermal power plant. The energy rate is Rs. 1.5 per kw-hr and cost of input is Rs. 2.2 per 20,000 kJ. The thermal efficiency is 40% at 120 MW load, 35% at 60 MW,30% at 40 MW and 20 % at 10 MW.
b) It is proposed to take the above load by a combined thermal and pumped storage plant. If the thermal plant always run at constant load with 40 % thermal efficiency and overall efficiency of pump storage plant is 80% find the capacity of the thermal plant required and percentage increase in the revenue earned. The cost of power- sell and cost of energy input is same as given above</td><td>20</td><td>CO3, 4</td></tr>
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SECTION A

		Marks	CO
Q 1	Find the energy equivalence of 1 atomic mass unit.	**4**	**CO1**
Q 2	Explain briefly the term Radioactivity and Multiplication factor.	**4**	**CO1**
Q 3	Define the conversion process parameter in nuclear power plant.	**4**	**CO5**
Q 4	The available discharge and head at a proposed site of hydro-electric power plant is 340 m^3/sec and 30 m respectively. The turbine efficiency is 88%. The generator is directly connected to the turbine. The poles used are 24. Find least number of machines required if a Francis turbine with a specific speed of 300 is used.	**4**	**CO4**
Q 5	Classify the underground hydro power plants with their merits and demerits.	**4**	**CO3**

SECTION B

Q 6	a) Describe the term cavitation and how we can avoid. b) A hydroelectric station is designed to operate at a mean head of 205 meter and fed by a reservoir having a catchment area of 1000 km^2 with an annual rainfall of 125 cm of which 80% is available for power generation. The expected load factor is 75%. Allowing a head loss of 5m and assuming efficiency of turbine and generator to be 0.9 and 0.95. Calculate suitable MW rating of the station. Comment on the type of turbine to be used.	**5+5**	**CO4**
Q 7	An isotope has a half-life of 41 days then find a) Decay constant and average life b) What percentage of atoms initially present will decay in a period of 100 days.	**5+5**	**CO1**
Q 8	Discuss the constructional point of view the various types of turbine used in hydro power plant with neat diagram.	**10**	**CO3**
Q 9	Elaborate the working of AGR and BWR with neat diagram. OR Elaborate the function of Liquid metal reactor and PWR with neat diagram.	**10**	**CO5**

SECTION-C

Q 10

Month	J	F	M	A	May	J	J	A	S	O	N	D
River A	40	30	30	20	20	160	180	180	100	80	50	50
River B	50	50	60	80	100	100	90	90	70	60	60	60

The average monthly run off data of two rivers A and B for 12 months is tabulated as given below. The water source of river B is from a snow fall region. The run off is given in millions of cu-m per month.

The head available for river A is 80 meters and for B is 82 meters. Using above data, find:

i. Which river is more suitable for storage type hydro-electric power plant? Assuming the overall efficiency in both cases is same.
ii. If the quantity of water available must be assured for 85% of the time of the year, then find the ratio of power generation if both plants are used as run off river plants.
iii. The ratio of run off of river A and river B as well as ratio of power if the constant run off from both rivers is required for 60% of the year.
iv. At what percentage of time, the run off rate of both rivers is same?

20 | **CO3, 4**

Q 11

a) Derive the thermalisation process of Fast Neutrons.
b) Briefly describe the phenomenon of nuclear reactor control.

10+ 10 | **CO1, 5**