PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20 | Date: 30.09.2019
Course Code: EEE 310 | Time: 2:30PM to 3:30PM
Course Name: ELECTRICAL POWER GENERATION | Max Marks: 40
Program & Sem: B.Tech. (EEE) & V DE | Weightage: 20%

Instructions:

i. The Question papers consists of three parts.
ii. Answer all the questions according to the marks.
iii. All the diagrams are to be sketched legibly.

Part A

Answer all the Questions. Each Question carries two marks. (10x2M=20M)

1. What are the factors to be considered for the selection of thermal power plant? (C.O.NO.2) [Knowledge]
2. What are the types of Nuclear Reaction? (C.O.NO.2) [Knowledge]
3. Sketch the single line diagram of the electrical power system? (C.O.NO.2) [Knowledge]
4. Define commercial and non-commercial energy sources? (C.O.NO.2) [Knowledge]
5. Define Power plant and its importance? (C.O.NO.2) [Knowledge]
6. Define Mass Curve and its importance in Hydro power plant? (C.O.NO.2) [Knowledge]
7. What is the advantage of using surge tank in hydro power plant? (C.O.NO.2) [Knowledge]
8. Define Boiler and Give the types of boilers in steam power plant? (C.O.NO.2) [Knowledge]
9. List out stationary and non-stationary solar plate collectors? (C.O.NO.2) [Knowledge]
10. List different types of water turbines and its usage in hydro power plant? (C.O.NO.2) [Knowledge]

Part B

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

11. Sketch and briefly explain the working of speed governing system.
(C.O.NO.2) [Comprehension]
12. Compare in detail about the choice of site for thermal power plant and hydro power plant. (C.O.NO.2) [Comprehension]

Part C

Answer the Question. The Question carries ten marks. (1QX10M=10M)

13. Sketch and explain any two of the solar thermal energy conversion system.
(C.O.NO.2) [Application]

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

Semester: 5th SEM **Date**: 30-9-2019

Course Code: EEE 310 **Time**: 1Hr

Course Name: Electrical Power Generation (DE) **Max Marks**: 40M

Program & Sem: B.Tech & 5th **Weightage**: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1.	CO2	Module 1 & 2	2									2
2.	CO2	Module 1 & 2	2									2
3.	CO2	Module 1 & 2	2									2
4.	CO2	Module 1 & 2	2									2
5.	CO2	Module 1 & 2	2									2
6	CO2	Module 1 & 2	2									2
7	CO2	Module 1 & 2	2									2
8	CO2	Module 1 & 2	2									2
9	CO2	Module 1 & 2	2									2
10	CO2	Module 1 & 2	2									2

11	CO2	Module 1 & 2				5						5
12	CO2	Module 1 & 2				5						5
13	CO2	Module 1 & 2							10			10
	Total Marks		20			10			10			40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines.]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SOLUTION

Semester: 5th

Course Code: EEE310

Course Name: Electrical Power Generation (DE)

Date: 30-9-2019

Time: 1Hr.

Max Marks: 40M

Weightage: 20%

Part A (10 x 2M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Supply of Fuel, availability of water, Transportation facilities, Cost and type of land, Nearness to the load center and Distance from the populated area.	4*1/2= 2M	1Min
2	**Nuclear fission** is a process in **nuclear** physics in which the nucleus of an atom splits into two or	2*1 = 2M	1Min

	more smaller nuclei as fission products, and usually some by-product particles. Hence, **fission** is a form of elemental transmutation. **Nuclear fusion** is the process of making a single heavy nucleus (part of an atom) from two lighter nuclei. This process is called a nuclear reaction. It releases a large amount of energy. The nucleus made by **fusion** is heavier than either of the starting nuclei		
3	Single line diagram including the generation, transmission and distribution	1*2=2	1Min
4	• The commercial energy sources are the one available in market for a definite price (thermal power, Nuclear Power, Hydro power) • The non-commercial ES are not available in market for price (Solar, Wind, Dung Cake).	2*1 = 2M	1Min
5	➢ A power plant is an assembly of systems or subsystems to generate and deliver mechanical or electrical energy. ➢ The power plant must be efficient, economic and environmental friendly. ➢ The main pieces of equipment for the generation of power in a PP are prime mover and generator	1*2=2M	1Min
6	Mass curve is the curve that indicates volume of flow versus the time in months. In case of mass curve, the mean monthly flow in second meter is recorded and then accumulative flow in second metre month is calculated. Generally the mean monthly flow in second metre is calculated by taking the average flow in second metre from the daily records of the month.	1*2=2M	1Min
7	A surge tank is just built just before the valve house and protects the penstock from bursting in case the turbine gates suddenly closed due to electrical load being thrown off. When the gates close there is a sudden stoppage of water at the lower end of the penstock and consequently the penstock can burst like a paper log. The surge tank absorbs this pressure by increasing in its level of water.	1*2=2M	1Min
8	A boiler is a closed vessel in which water is converted into steam by utilizing the heat of coal	1*2=2M	1Min

	combustion. They are classified as water tube boilers and fire tube boilers		
9	➢ Non-concentrating collectors: ➢ Flat plate collectors (FPC) ➢ Stationary compound parabolic collectors (CPC); ➢ Evacuated tube collectors (ETC) ➢ Concentrating solar collectors: ➢ Parabolic trough collector ➢ Linear Fresnel reflector (LFR) ➢ Parabolic dish ➢ Central receiver	2*1 = 2M	1Min
10	Impulse Turbine. Reaction Turbine : Kaplan and Francis Turbine	2*1 = 2M	1Min

Part B (Any Two Questions) (2Q x 5M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
11	Diagram and working of speed governing system.	3M+2M = 5M	10Min
12	Diagram of PWR and its working	3M+2M = 5M	10Min
13	Five aspects in each site selection of TPP and HPP.	2*1/2 M + 2*1/2 M = 5M	10Min

Part C (any one to be answered) (1 x 10M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
14	Solar water Heating. Solar Distillation. Solar Wax Melter. Solar Swimming pool. Solar ponds. Solar pumping system. Solar Crop drying. Solar Air-conditioning and Refrigeration.	Any two to be explained with neat diagram. 2*5 M = 10M	20Min
15	Diagram NPP. Explain the working of Nuclear power plant.	4M+3M+4M+4M = 15M	20Min

	Advantages, disadvantages and site selection aspects.		

Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Semester: 5th SEM
Course Code: EEE 310
Course Name: Electrical Power Generation (DE)
Program & Sem: B.Tech & 5th

Date: 16-11-19
Time: 1Hr
Max Marks: 40M
Weightage: 20%

Instructions:

(i) *The Question papers consists of three parts.*
(ii) *Answer all the questions according to the marks.*
(iii) *All the diagrams are to be sketched legibly.*

Part A

Answer all the Questions. **(5x3=15M)**

1. Define (a) Domestic Load (b) Irrigation Load and (c) Commercial Load **(CO3).**

   [Knowledge] [1M+1M+1M]

2. List out classification of wind turbine and the importance of lift and drag type turbines. **(CO2) [Knowledge] [1M+2M].**
3. Discuss the key benefits of fuel cells? **(CO2) [Knowledge] [6*1/2 = 3M]**
4. List out the classifications of energy storage system? **(CO2) [Knowledge] [6*1/2=3M]**
5. Briefly explain the significance of power duration curve and velocity duration curves? **(CO2) [Knowledge] [3M]**

Part B

Answer the following Questions. **(3x5M=15M)**

6. Illustrate the concept of a wind farm when integrated with grid. **(CO2) [Comprehensive].**

   [3M+2M=5M]

7. Compare the technical characteristics of energy storage technologies **(CO2) [Comprehensive]. [5M]**
8. Define Load Curve and predict the effects of variable load. **(CO3) [Comprehensive] [2M+3M=5M].**

Part C

Answer any one of the following Questions. (1*10M=10M)

9. Obtain the Expression for basic principle of wind energy conversion system **(CO2) [Comprehensive] [10M]**

PRESIDENCY UNIVERSITY
BENGALURU

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

Semester: 5^{th} SEM

Course Code: EEE 310

Course Name: Electrical Power Generation (DE)

Program & Sem: B.Tech & 5^{th}

Date: 16-11-2019

Time: 1Hr

Max Marks: 40M

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1.	CO3	Module 3	3									3
2.	CO3	Module 3	3									3
3.	CO2	Module 2	3									3
4	CO2	Module 2	3									3
5	CO2	Module 2	3									3
6	CO2	Module 3				5						5
7	CO2	Module 3				5						5
8	CO2	Module 2				5						5
9	CO2	Module 2				10						10

	Total Marks		15			25						40M

K =Knowledge Lev-! C = Comprehension Level, A = Application Level

Note: While setting -ll types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexu - II: nat of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: 5[th] SEM

Course Code: EEE 3

Course Name: El l Power Generation (DE)

Date: 16-11-2019

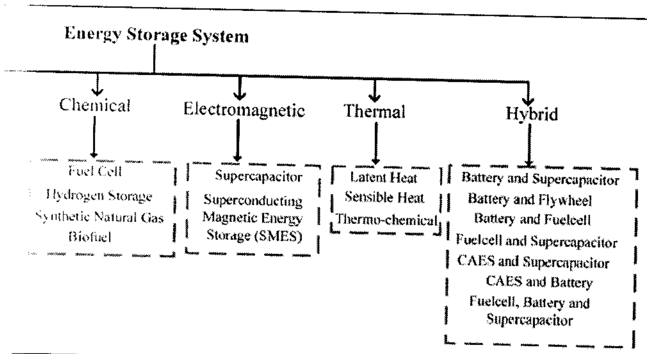
Time: 1Hr

Max Marks: 40M

Weightage: 20%

Part A (5 x 2M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	*(i)* stic nestic load consists of lights, fans, refrigerators, heaters, television, small mo for p ter etc. Most of the residential load occurs only for some hours during the day (*i.e.* hou hting load occurs during night time and domestic appliance load occurs for only a few hours reason, the load factor is low (10% to 12%). *(ii)* Commerci Commercial load consists of lighting for shops, fans and electric appliances used in restau This class of load occurs for more hours during the day as compared to the domestic load. nercial load has seasonal variations due to the extensive use of air-conditioners and sp *(v)* ype of load is the electric power needed for pumps driven by motors to supply rally this type of load is supplied for 12 hours during night.	1M+1M+1M = 3M	3M
2	WT are classifie rizontal and vertical axis turbines depending upon the orientation of ax tation of rotors. ▶ Tw ics principles: Lift and Drag. ▶ rotor of a WT either by lifting the blades (Lift) or by he plates (Drag).	Classification: 1M. Any four points in	3M

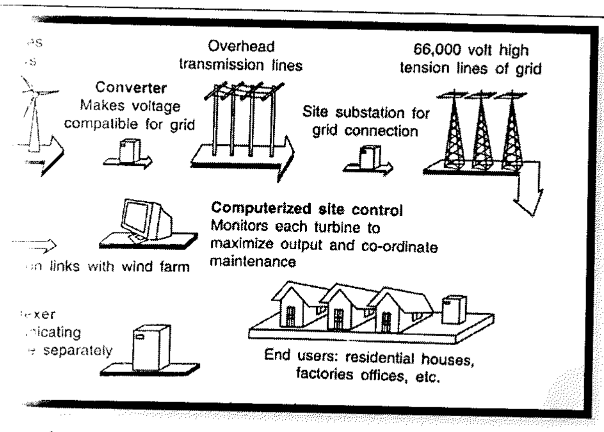
	▶ Th... identified based on the geometry and the manner in wh... passes over the blades. ▶ S... mainly driven by Drag forces acting on the rotor. ▶ Hig... the rotor shaft. ▶ Gr... a is required. ▶ S... done using the curved blades. ▶ L... mainly driven by Lift forces to move the bladed. ▶ F... quires aerofoil type blades to minimize the adverse e... es. ▶ ... ne from aerofoil sections with a high thickness-to-... ler to produce a high lift relative to drag. ▶ ... ft of the generator requires to be driven at high speed. ▶ ... ept area, the energy extracted by a wind turbine ... rces is several times greater than the energy from ... ne. ▶ ... ft type turbines are more suitable compared to Drag	Importance: 2M	
3	▶ ... and gravimetric efficiency ▶ ... ustic, and thermal emissions ▶ ... ng flexibility ▶ ▶ ... pending on type of fuel cell) ▶ ... ollutants	Any Six among the Advantages 6*1/2M = 3M	3M
4	M... Pumpe... Compre...  	Any Four Batteries 4*1/2M	3M
5	▶ ... ity duration curve – Weibulls Distribution. ▶ ... rve – Wind turbine response data equivalent - ... e. ▶ ... vind speed exceeding any specific value is termed ... tion characteristic - from these probabilities VD ... ructed. ▶ ... s the annual hours of duration of wind speed and ... it was likely to exceed a certain value of wind ... the data was measured. ▶ ... he equivalent PD curve can be constructed. The po... provides the expected power generation over the operati... ed.	PD Curve Importance (1.5M) + VD Curve (1.5M)	3M

Part B

(3Q x 5M = 15Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	see below	Diagram (3M) + Explanation (2M) = 5M	5M
7	see below	Any Five Technical Characteristics need to be compared with any five 5*1M=5M	5M

6



...nd explanation on the same is required.

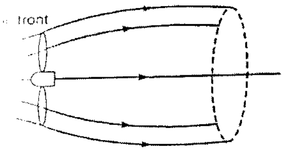
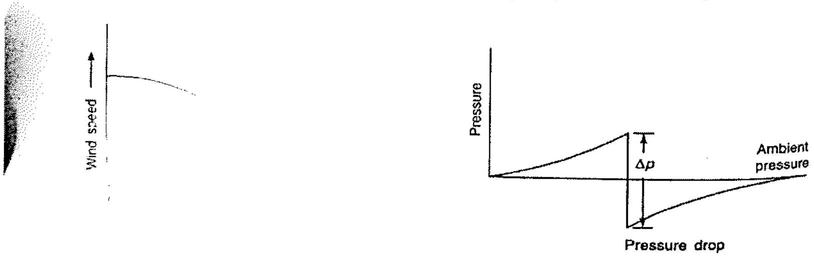
7

...have been Realized and are Currently in Use and Development

	DMFC Direct Methanol	PAFC Phosphoric Acid	MCFC Molten Carbonate	SOFC Solid Oxide
	60-120	160-220	600-800	800-1000 Low temperature (500-600) possible
	Perfluoro sulfonic acid (Nafion membrane)	H_3PO_4 immobilized in SiC matrix	Li_2CO_3-K_2CO_3 eutectic mixture immobilized in γ-$LiAlO_2$	YSZ (yttria stabilized zirconia)
	H^+	H^+	CO_3^{2-}	O^{2-}
	$CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$	$H_2 \rightarrow 2H^+ + 2e^-$	$H_2 + CO_3^{2-} \rightarrow H_2O + CO_2 + 2e^-$	$H_2 + O^{2-} \rightarrow H_2O + 2e^-$
	$3/2 O_2 + 6H^+ + 6e^- \rightarrow 3H_2O$	$½O_2 + 2H^+ + 2e^- \rightarrow H_2O$	$½O_2 + CO_2 + 2e^- \rightarrow CO_3^{2-}$	$½O_2 + 2e^- \rightarrow O^{2-}$
	Anode: Pt, PtRu Cathode: Pt	Anode: Pt, PtRu Cathode: Pt	Anode: Ni-5Cr Cathode: NiO(Li)	Anode: Ni-YSZ Cathode: lanthanum strontium manganite (LSM)
		Combined heat and power for decentralized stationary power systems	Combined heat and power for stationary decentralized systems and for transportation(trains, boats, ...)	
	Small plants <5 kW	Small-medium sized plants 50 kW-11 MW	Small power plants 100 kW-2 MW	Small power plants 100-250 kW
	SFC Energy (Germany)	UTC Power (USA) Fuji Electric (Japan)	Fuel Cell Energy (USA)	Ceramic Fuel Cells Limited (Australia) Hexis & Vaillant (Germany) SOFC Power (Italy) Bloom Energy (USA)
	1,000 h	>50,000 h	7,000-8,000 h	1,000 h

8	know...	...verage load to the maximum demand during a given period is $\dots = \frac{\text{Average load}}{\text{Max. demand}}$ ...riable load on a power station introduces many perplexities in ... effects of variable load on a power station are : ...nt. The variable load on a power station necessitates to have ...y of illustration, consider a steam power station. Air, coal and ...for this plant. In order to produce variable power, the supply of ...ired to be varied correspondingly. For instance, if the power ...ses, it must be followed by the increased flow of coal, air and ... meet the increased demand. Therefore, additional equipment ...sh this job. As a matter of fact, in a modern power plant, there ...ntirely to adjust the rates of supply of raw materials in accor... made on the plant. ... The variable load on the plant increases the cost of the pro... An alternator operates at maximum efficiency near its rated ...or is used, it will have poor efficiency during periods of light ... in actual practice, a number of alternators of different capaci... of the alternators can be operated at nearly full load capacity. ...r of generating units increases the initial cost per kW of the ...rea required. This leads to the increase in production cost of	Load Curve 2M + Effects of Variable Load (3M) = 5M	5M

Part C (1 x 10M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
10	**7.7 WI... ...ION** Wind turbin... stream by converting the kinetic energy of the wind to rotational ... electric generator. By virtue of the kinetic energy, the velocity of ... It is assumed that the mass of air which passes through rotor is only ... e from the air which does not pass through the rotor. Accordingly, ... e is drawn showing the affected air mass and this boundary is ... s downstream as detailed in Figure 7.9.  ...tion of wind flow through turbine. As the free ... with the turbine rotor, the wind transfers part of its energy into ... e wind decreases to a minimum leaving a trail of disturbed ... a)]. The variation in velocity is considered to be smooth ... n. However, the fall in static wind pressure is sharp as depict... aving the rotor is below the atmospheric pressure (in wake ... egains its value to reach the atmospheric level. The rise in sta... nergy, consequently further decreasing the wind speed.  (b) F... d and pressure in traversing the turbine rotor. Wi... e and hence the air stream flow diverges as it passes throu... of wind is assumed constant at far upstream, at the roto... he mathematical relationships, suppose:	Importance and Derivation 10M	20Min

P = ai...
P_u = p...
P_d = p...
V = ai...
V_u = v...
V_b = v...
V_d = vel... ...me before the wind front reforms and
re...
A = ar...
$\bar{M}$ = m...
ρ = ai...

The kinetic ... turbine rotor is

and

Hence, ... (7.1)

The force on ...

... (7.2)

Force on th... ...mentum per unit time from upstream to downstream ...w

... (7.3)

Applying the ... ...nstream sides,

$$... \rho V_b^2 \quad (7.4)$$

$$... \rho V_d^2 \quad (7.5)$$

Solving Eqs ...

$$... - V_d^2) \quad (7.6)$$

Equating Eqs ...

$$... V_b(V_u - V_d) \quad (7.7)$$

Solving ...

$$... V_u - V_d)$$

(7.8)

or

In a wind tu... ...equal to the difference in kinetic energy between u... ...unit massflow, $\bar{M}$ = 1. Therefore,

... (7.9)

The powe... ...done, using the mass flow rate equation.

$$... \frac{... - V_d^2}{2}\right)$$

$$... - V_d^2) \quad (7.10)$$

For maxim... ...with respect to V_d and equate to zero to obtain

$$... V_u^2 = 0$$

The above qu... $V_d = \frac{1}{3} V_u$ and $V_d = V_u$

For power g... $V_d = \frac{1}{3} V_u$ (7.10a)

Therefore,

(7.11)

$$... V_u^3)$$

Total power is

$$P_{total} = \frac{1}{2}\rho A V_u^3 \qquad (7.11a)$$

Therefore,

$$P_{max} = 0.593 P_{total}$$

Maximum theoretic ... (also called the power coefficient C_p) is the ratio of maximum o... available in the wind, i.e.,

$$\text{...efficient, } C_p = \frac{P_{max}}{P_{total}} = 0.593 \qquad (7.12)$$

The factor 0.5... ...z limit (After the name of the engineer who first derived this relation...

Availa...

Theoretic... extracted by a turbine rotor is 59.3% of the total wind energy in ...r. Considering the rotor efficiency to be 70%, bearing, vibrations, ...tor efficiency 90%, the available efficiency η is 60% of C_p, i.e.,

$$\eta_a = 0.6 \times 0.593$$
$$= 35.5\%$$

7.8 F... D TURBINE POWER

Equation (... as $P_{total} = \frac{\rho}{2} \cdot \frac{\pi}{4} D^2 V_u^3$. Accordingly, for a given wind speed at a ... four times if the rotor diameter is doubled. The designer of a wind tu... ...se the rotor diameter to optimize the extraction of the wind energy. ... ...ind speed and rotor diameter on the availability of wind power c... ...11.

Wi... it is necessary to know the energy needs and the availability of wind ... ...onomically, it is known that the wind system cost varies accord... ...to Figure 7.11, if the rotor diameter of 40 m is selected in lieu of ... ...having wind speed of 10 m/s, the available power rises up to 1 MW, i.e., becomes four times more.

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 | **Date**: 26 December 2019

Course Code: EEE 310 | **Time**: 9:30 AM to 12:30 PM

Course Name: ELECTRICAL POWER GENERATION | **Max Marks**: 80

Program & Sem: B.Tech (EEE) & V (DE – I). | **Weightage**: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Sketch the diagrams legibly.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. (10Qx2M=20M)

1. Briefly list out the problems with India's power sector (C.O.No.1) [Knowledge]

2. Recall any four Nuclear Power Plant which are under construction in India with the total capacity (C.O.No.1) [Knowledge]

3. List the factors for site selection of Nuclear Power plant. (C.O.No.2) [Knowledge]

4. Define Runoff and Mass Curve (C.O.No.2) [Knowledge]

5. Define Beam and Diffused Radiation (C.O.No.3) [Knowledge]

6. List out any eight components of Wind mill (C.O.No.3) [Knowledge]

7. Define and Express Plant capacity factor and Plant use Factor (C.O.No.4) [Knowledge]

8. Recall and brief the importance of high load factor (C.O.No.4) [Knowledge]

9. Define and give the expressions of two part tariff and three part tariff. (C.O.No.5) [Knowledge]

10. Brief the causes of Low power factor (C.O.No.5) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. (4Qx10M=40M)

11. (a) Explain if using nuclear power really the answer to clean, environmentally friendly energy [2M]

(b) What kind of resources does nuclear energy require? With this in mind, is it worth the effort and the investment to acquire nuclear energy? [2M]

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SCHOOL OF ENGINEERING

Semester: Odd Semester: 2019 - 20
Course Code: EEE 310
Course Name: ELECTRICAL POWER GENERATION
Program & Sem: B.Tech (EEE) & 5th.

Date: 26th Dec 2019
Time: 9:30 AM – 2:30PM
Max Marks: 80
Weightage: 40 %

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	C	
PART A Q. NO 1 - 10	CO 01 CO 02 CO 03 CO 04 CO 05	All the 5 modules	[10*2 = 20M]			20
PART B Q.NO.11	CO 02	MODULE 02	-	[2+2+6 =10M]	-	10
PART B Q.NO.12	CO 03	MODULE 3	-	5+5 =10M	-	10
PART B Q.NO.13	CO 04	MODULE 4	-	4	6	10

PART B Q.NO.14	CO 05	MODULE 5	-	[4+6 = 10M]	-	10
PART C Q.NO.15	CO 04	MODULE 04	-	-	10	10
PARTC Q.NO.16	CO 05	MODULE 05	-	-	10	10
	Total Marks		20	34	26	80

K =Knowledge Level C = Comprehension Level, A = Application Level

C.O WISE MARKS DISTRIBUTION:

CO 01: 4 MARKS, CO 02: 14 MARKS, CO 03: 14 MARKS, CO 04: 24 MARKS and CO 05: 24 MARKS

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

All Co's are tested

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SOLUTION

Semester: Odd Semester: 2019 - 20

Course Code: EEE 310

Course Name: ELECTRICAL POWER GENERATION

Program & Sem: B.Tech (EEE) & 5th.

Date: 26th Dec 2019

Time: 9:30 AM – 12:30PM

Max Marks: 80

Weightage: 40 %

Part A (10 x 2M = 20Marks)

<table>
<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time required for each Question</th></tr>
<tr><td>1</td><td>Inadequate last mile connectivity, Demand build up measures, Unequal electricity distribution, Erratic power pricing, Over-rated capacity. Lack of timely information on load and demand, Lack of adequate coal supply, Poor gas pipeline connectivity and infrastructure. Transmission, distribution and consumer-level losses. Resistance to energy efficiency in the residential building sector. Resistance to hydroelectric power projects. Resistance to nuclear power generation. Theft of power.</td><td>Any four problems 2M</td><td>3Min</td></tr>
<tr><td>2</td><td><table>
<tr><th>[illegible]</th><th>[illegible]</th><th>[illegible]</th><th>[illegible]</th><th>[illegible]</th><th>[illegible]</th><th>[illegible]</th></tr>
<tr><td>Madras (Kalpakkam)</td><td></td><td></td><td></td><td>500 x 1</td><td>500</td><td>2020</td></tr>
<tr><td></td><td></td><td></td><td></td><td>700 x 2</td><td>1,400</td><td>2022</td></tr>
<tr><td></td><td></td><td></td><td></td><td>700 x 2</td><td>1,400</td><td>2025</td></tr>
<tr><td></td><td></td><td></td><td></td><td>700 x 2</td><td>1,400</td><td>2022</td></tr>
<tr><td>Kudankulam</td><td>NPCIL</td><td>Tamil Nadu</td><td>VVER 1000</td><td>100 x 2</td><td>2,000</td><td>2026</td></tr>
</table></td><td>2M</td><td>3Min</td></tr>
<tr><td>3</td><td>former, circuit breakers and isolators.

2.15 Selection of Site for Nuclear Power Station
The following points should be kept in view while selecting the site for a nuclear power station :
(i) Availability of water. As sufficient water is required for cooling purposes, therefore, the plant site should be located where ample quantity of water is available, e.g., across a river or by sea-side.
(ii) Disposal of waste. The waste produced by fission in a nuclear power station is generally radioactive which must be disposed off properly to avoid health hazards. The waste should either be buried in a deep trench or disposed off in sea quite away from the sea shore. Therefore, the site selected for such a plant should have adequate arrangement for the disposal of radioactive waste.
(iii) Distance from populated areas. The site selected for a nuclear power station should be quite away from the populated areas as there is a danger of presence of radioactivity in the atmosphere near the plant. However, as a precautionary measure, a dome is used in the plant which does not allow the radioactivity to spread by wind or underground waterways.
(iv) Transportation facilities. The site selected for a nuclear power station should have adequate facilities in order to transport the heavy equipment during erection and to facilitate the movement of the workers employed in the plant.
From the above mentioned factors it becomes apparent that ideal choice for a nuclear power station would be near sea or river and away from thickly populated areas.</td><td>2M</td><td>3Min</td></tr>
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<tr><td>9</td><td>

4. **Two-part tariff.** *When the rate of electrical energy is charged on the basis of maximum demand of the consumer and the units consumed, it is called a two-part tariff.*

$$\text{Total charges} = \text{Rs}\,(b \times \text{kW} + c \times \text{kWh})$$

where, b = charge per kW of maximum demand
c = charge per kWh of energy consumed

This type of tariff is mostly applicable to industrial consumers who have appreciable maximum demand.

7. **Three-part tariff.** *When the total charge to be made from the consumer is split into three parts viz., fixed charge, semi-fixed charge and running charge, it is known as a three-part tariff. i.e.,*

$$\text{Total charge} = \text{Rs}\,(a + b \times \text{kW} + c \times \text{kWh})$$

where a = fixed charge made during each billing period. It includes interest and depreciation on the cost of secondary distribution and labour cost of collecting revenues,
b = charge per kW of maximum demand,
c = charge per kWh of energy consumed.

</td><td>2M</td><td>3Min</td></tr>
<tr><td>10</td><td>

6.4 Causes of Low Power Factor

Low power factor is undesirable from economic point of view. Normally, the power factor of the whole load on the supply system in lower than 0·8. The following are the causes of low power factor:

(*i*) Most of the a.c. motors are of induction type (1ϕ and 3ϕ induction motors) which have low lagging power factor. These motors work at a power factor which is extremely small on light load (0·2 to 0·3) and rises to 0·8 or 0·9 at full load.

(*ii*) Arc lamps, electric discharge lamps and industrial heating furnaces operate at low lagging power factor.

(*iii*) The load on the power system is varying ; being high during morning and evening and low at other times. During low load period, supply voltage is increased which increases the magnetisation current. This results in the decreased power factor.

</td><td>2M</td><td>3Min</td></tr>
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Part B (4Q x 10M = 40Marks)

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<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time required for each Question</th></tr>
<tr><td>11</td><td>

(a) No. There is nothing environmentally friendly about nuclear power. It only creates different environmental problems than fossil fuel energy sources. But neither fossil fuels nor nuclear power are safe, sustainable, or healthy for humans and the environment.

(b) Nuclear power requires a lot of uranium to make the fuel and produces a lot of radioactive waste in the process. Building and constructing reactors requires a lot of steel, concrete, and rare earth metals; there is a large carbon emissions footprint associated with just the construction of nuclear power plants. There is also the question of what to do with nuclear reactor sites once they close down. These reactor sites become highly contaminated with radioactive and chemical waste and byproducts. After they shut down, the equipment must be dismantled and the heavily contaminated and radioactive steel, concrete, machinery, clothing, etc., is removed to be “disposed of.” Frequently, the government and energy companies are looking for places to dump radioactive waste. These dump sites often times end up in communities of color or indigenous communities specifically targeted due to their lack of political power.

</td><td>2+2+6=10M</td><td>15Min</td></tr>
</table>

Fuel-cell technology	Temperature (°C)	Efficiency (%HHV)[a]	Start-up time (h)[b]
PAFC	200	36–45	1–4
AFC	<100	>50 (direct)	<0.1
MCFC	650	43–55	5–10
SOFC (planar)	1000	43–55	–
PEMFC	<100	32–45 (indirect), >50 (direct H_2)	<0.1
DMFC	<100	–	<0.1

[a] HHV: higher heating value, i.e. the total heat released including the latent heat of vapourisation of the water formed by the oxidation process.

[b] For fuel-stack only, i.e. does not include response time for a fuel processor, if present.

	PEMFC	PAFC	MCFC	SOFC
Electrolyte	Membrane Polymer	Phosphoric Acid	Molten Mixture	Ceramic
Catalyst	Platinum	Platinum	Nickel	Perovskites
Temperature Operation	50- 80° C	150-200° C	≈650° C	800-1000° C
Output Power Range	50-250KW	< 200 KW	10KW-2MW	< 100KW
Efficiency	40-50%	40-80%	60-80%	~60%
Electrolyte	Membrane Polymer	Phosphoric Acid	Molten Mixture	Ceramic

13 (a)

Effects of variable load. The variable load on a power station introduces many perplexities in its operation. Some of the important effects of variable load on a power station are :

(*i*) **Need of additional equipment.** The variable load on a power station necessitates to have additional equipment. By way of illustration, consider a steam power station. Air, coal and water are the raw materials for this plant. In order to produce variable power, the supply of these materials will be required to be varied correspondingly. For instance, if the power demand on the plant increases, it must be followed by the increased flow of coal, air and water to the boiler in order to meet the increased demand. Therefore, additional equipment has to be installed to accomplish this job. As a matter of fact, in a modern power plant, there is much equipment devoted entirely to adjust the rates of supply of raw materials in accordance with the power demand made on the plant.

(*ii*) **Increase in production cost.** The variable load on the plant increases the cost of the production of electrical energy. An alternator operates at maximum efficiency near its rated capacity. If a single alternator is used, it will have poor efficiency during periods of light loads on the plant. Therefore, in actual practice, a number of alternators of different capacities are installed so that most of the alternators can be operated at nearly full load capacity. However, the use of a number of generating units increases the initial cost per kW of the plant capacity as well as floor area required. This leads to the increase in production cost of energy.

5M
5M

15Min

(b)

Solution.

(*i*) $\text{Load factor} = \dfrac{\text{Average demand}}{\text{Maximum demand}}$

or $0{\cdot}60 = \dfrac{\text{Average demand}}{25}$

$\therefore$ $\text{Average demand} = 25 \times 0{\cdot}60 = 15 \text{ MW}$

$\text{Plant capacity factor} = \dfrac{\text{Average demand}}{\text{Plant capacity}}$

$\therefore$ $\text{Plant capacity} = \dfrac{\text{Average demand}}{\text{Plant capacity factor}} = \dfrac{15}{0{\cdot}5} = 30 \text{ MW}$

	(b) **26.8 Advantages of Neutral Grounding** The following are the advantages of neutral grounding : (*i*) Voltages of the healthy phases do not exceed line to ground voltages *i.e.* they remain nearly constant. (*ii*) The high voltages due to arcing grounds are eliminated. (*iii*) The protective relays can be used to provide protection against earth faults. In case earth fault occurs on any line, the protective relay will operate to isolate the faulty line. (*iv*) The overvoltages due to lightning are discharged to earth. (*v*) It provides greater safety to personnel and equipment. (*vi*) It provides improved service reliability. (*vii*) Operating and maintenance expenditures are reduced.		

Part C (2 x 10M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
15	**Solution :** Initial cost of equipment, P = Rs 15,60,000 Salvage value of equipment, S = Rs 60,000 Useful life, n = 25 years (*i*) *Straight line method* Annual depreciation $= \frac{P-S}{n} = \text{Rs}\ \frac{15{,}60{,}000 - 60{,}000}{25} = \text{Rs}\ 60{,}000$ Value of equipment after 20 years $= P - \text{Annual depreciation} \times 20$ $= 15{,}60{,}000 - 60{,}000 \times 20 = \text{Rs}\ 3{,}60{,}000$ (*ii*) *Diminishing value method* Annual unit depreciation, $x = 1 - (S/P)^{1/n}$ $= 1 - \left(\frac{60{,}000}{15{,}60{,}000}\right)^{1/25} = 1 - 0{\cdot}878 = 0{\cdot}122$ Value of equipment after 20 years $= P(1-x)^{20}$ $= 15{,}60{,}000\,(1 - 0{\cdot}122)^{20} = \text{Rs}\ 1{,}15{,}615$ (*iii*) *Sinking fund method* Rate of interest, $r = 5\% = 0{\cdot}05$ Annual deposit in the sinking fund is $q = (P-S)\left[\frac{r}{(1+r)^n - 1}\right]$ $= (15{,}60{,}000 - 60{,}000)\left[\frac{0{\cdot}05}{(1+0{\cdot}05)^{25} - 1}\right]$ $= \text{Rs}\ 31{,}433$ ∴ Sinking fund at the end of 20 years $= q\frac{(1+r)^{20} - 1}{r} = 31{,}433\,\frac{(1+0{\cdot}05)^{20} - 1}{0{\cdot}05} = \text{Rs}\ 10{,}39{,}362$ Value of plant after 20 years = Rs (15,60,000 − 10,39,362) = Rs 5,20,638	10M	15Min