Duration: 3 Hours Total Marks : 80

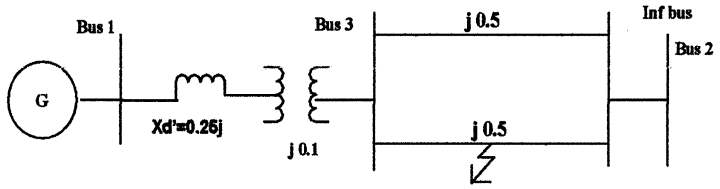
NOTE

1.Question number 1 is compulsory
2.Attempt any three from the remaining
3.Figures to right indicates full marks
4.Assume suitable data if necessary and mention the same

1. Attempt any four of the following :- 20

a) Explain why frequency control loop and voltage control loop are not interacting 05

b) 05



For the system shown if fault occurs at the middle of the line. Find transfer reactance between bus 1 and 2 by **NODE ELIMINATION** technique only

c) Define power system stability and classify it on the basis of nature of disturbance 05

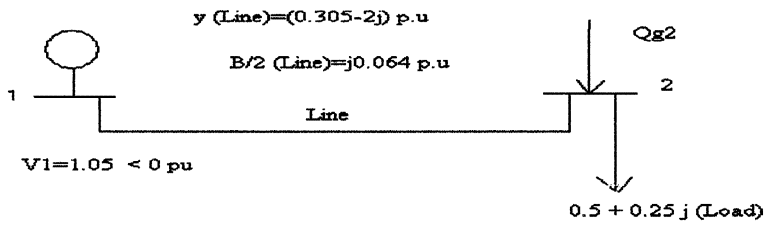
d) State assumptions made in transient stability studies 05

e) What are the characteristics of Ybus matrix, also explain the advantages of using Ybus matrix for load flow studies 05

2. 20

a) Explain Y_{BUS} formation by singular transformation 10

b) A simple two-bus power system is shown in fig 10



$|V_2|$ =1.0 p.u (Bus 2 is PV bus). Obtain δ_2 and Q_{g2} at the end of first iteration of N-R method.

3. 20

a) The fuel cost functions for three thermal plant in Rs/h are given by 10

$$C_1=500+5.3P_1+0.004P_1^2$$
$$C_2=400+5.5P_2+0.006P_2^2$$
$$C_3=200+5.8P_3+0.009P_3^2$$

Where P_1, P_2 and P_3 are in MW. The total load P_D is 975 MW with following generator limits (in MW)

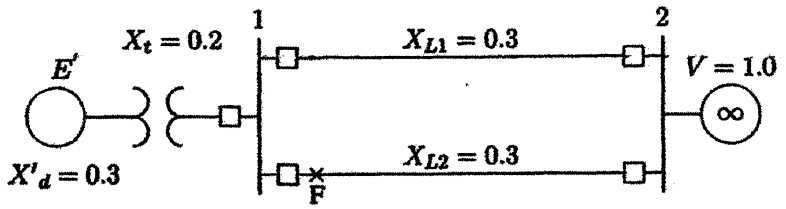
$$200 \leq P_1 \leq 450$$
$$150 \leq P_2 \leq 350$$
$$100 \leq P_3 \leq 225$$

Find the optimal dispatch and the total cost in Rs/h

b) Derive formula for Bmn coefficients in transmission loss formula 10

4. 20

a) A 50 Hz synchronous generator having inertia constant H= 5 MJ/MVA and a direct axis transient reactance xd'=0.3 p.u is connected to an infinite bus through a purely reactive circuit as shown in figure below. Reactances are marked on the diagram on a common system base. The generator is delivering real power Pe=0.8 pu and Q=0.074 p.u to the infinite bus at a voltage of V=1 p.u. A temporary three phase fault occurs at the sending end of the line at point F. When the fault is cleared, both the lines are intact. Determine the critical clearing angle and the critical fault clearing time 10



b) A syncronous generator having H= 8 MJ/MVA is connected to an infinite bus and supplying power of 1 pu with initial power angle as 25 degree. Assume three phase fault occurring at t=0 and cleared at t=0.2 sec. The power equations expressed in pu are as under 10
Power transfer in pre-fault condition=2.5 sin δ
Power transfer in during-fault condition=0.6 sin δ
Power transfer in post-fault condition=1.5 sin δ. The system frequency is 50 Hz, use Modified Euler's method to solve the swing equation with step size 0.05 till the fault is cleared

5. 20

a) Derive turbine speed governor model 10

b) Explain dynamic response of change in frequency for step change in load of an isolated power system. How dynamic response changes with integral control action 10

6. Write short notes on (any two) 20

a) power pool and its advantages and disadvantages 10

b) Surge impedance and surge impedance loading 10

c) AGC in restructured power system 10

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(3 Hours) (Total Marks : 80)

N. B.
(1) Question No. **1** is **compulsory**.
(2) **Attempt** any **three** questions out of remaining questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) **Assume** suitable **data** if **necessary**.

1. Solve any **four** :- 20
   a) Compare HVDC links and state application of each
   b) Classify the faults in HVDC
   c) Explain EPC scheme of firing of HVDC converter bridge
   d) Create complete control characteristics HVDCT
   e) Show placement of harmonic filters in HVDCT

2. a) Discuss desired features of control of HVDC and explain basic control characteristic 10
   b) Investigate that double commutation failure is a self-clearing fault. 10

3. a) A 3-phase bridge rectifier has input voltage 345KV. Calculate DC voltage output when μ is 15^0 and α (i) 0^0 (ii) 15^0 (iii) 30^0 . 10
   b) For a bridge converter with grid control and overlap less than 60^0. Prove that 10

$$cos\emptyset \cong cos \propto - \frac{R_C . I_d}{V_{do}}$$

4. a) Illustrate use of bypass valve in HVDC 10
   b) How 'Power reversal' is done in HVDC'? 10

5. a) Explain over voltage and over current protection of HVDC 10
   b) Illustrate with neat diagrams and wave forms the principal of twelve-pulse converter. 10

6.
   a) Summarize the harmonics and filters in HVDCT 10
   b) Discuss in detail - 'Ground return' 10

Duration:- Three Hours **Total Marks Assigned:- 80**

NOTE
1. Question No 1 is Compulsory.
2. Solve any three out of the remaining.
3. Figure to the right side indicates marks.
4. Assume the suitable data and mention the same if required

QNo 1 Answer the following
a. Discuss the classification of insulating materials based on temperature [5]
b. What is gross and net iron area? How stepping of core affects it? [5]
c. What are the various factors affecting the sizing of a machine? [5]
d. How the relationship between D and L affect the design of motor? [5]

Q2a Derive the output equation of a three phase transformer. [10]
Q2b Calculate the overall dimensions of a 200 KVA, 6600/440V, 50 Hz, 3 phase core type transformer with data, emf per turn= 10V, maximum flux density=1.3 Wb/m^2, current density=2.5 A/mm^2, window space factor=0.3, overall height =overall width, stacking factor=0.9.Use three step core. [10]

Q3a What are the various assumptions in the leakage reactance calculation for a transformer. [10]

Q3b 250KVA, 6600/400V, 3 phase, core type transformer has a total loss of 4,800 W at full load. The transformer tank is 1.25m in height and 1m x 0.5m in plan. Design a suitable scheme for tubes if the average temperature rise is to be limited to 35^o C. The diameter of tube is 50mm and is spaced 75mm from each other. The average height of tube is 1.05m. Specific heat dissipation due to radiation and convection is6 and 6.5 W/m^2-^{O}C.Assume that convection is improved by 35% due to provision of tubes. [10]

Q4a Derive the output equation for a three phase induction motor. [10]

Q4b Determine the main dimensions, total conductors, area of a slot and conductor area, for a 250 HP, 400V, 3 phase,4 pole, 50Hz, delta connected squirrel cage induction motor with the data, average flux density in air gap= 0.5 Wb/m2, ampere conductor per meter=30,000A/m, efficiency= 0.9, power factor=0.9,winding factor = 0.955,current density= 3.5A/mm2,slot space factor =0.4,ratio of length of core to pole pitch=1.2, Assume 5 slots per pole per phase. [10]

Q5a Explain the terms total magnetic loading, total electric loading, specific magnetic loading, and specific electric loading in case of motors [10]

Q5b A 11 KW, 3 Phase, 220V, 6 Pole, 50Hz, 220V, Star connected squirrel cage induction motor has following data. The machine has efficiency of 0.86 and power factor of 0.85. The other data is S**tator Data:-**Number of slots = 54, conductor per slot = 9; **Rotor Data:-** Number of slots= 64,rotor mmf= 0.85 times stator mmf. Find the area of rotor bar, area of end ring if current density is 5A/mm^2. [10]

Q6a Discuss the design features of cross over winding and helical winding [10]
Q6b Discuss the design modification in the stator and rotor of a energy efficient motor. [10]

(3 Hours) **Total Marks - 80**

N.B.
i) Question No. 1 is compulsory.
ii) Attempt any three questions from remaining.
iii) Assume suitable data (mention the same) and use semi log paper wherever necessary.
iv) Figures to the right indicate full marks.

Q.1 Attempt any **Four**
A) What is compensator? Compare lag and lead compensator. [05]
B) Explain different forms of Industrial PID controllers. [05]
C) What is an observer? Explain the different types of observer. [05]
D) Explain the "Tustin transformation" method. [05]
E) Explain the PLC scan cycle. [05]
F) Explain the working principle of "Down Counter" of PLC. [05]

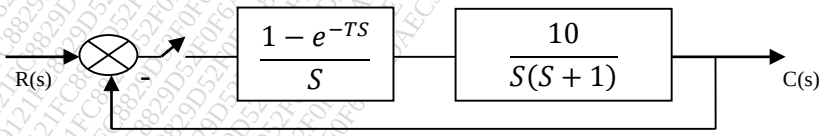
Q.2
A) Find the value of gain "K" for a unity feedback system with a forward transfer function $G(s) = \frac{K}{S(S+36)(S+100)}$, for 20% overshoot . [10]

B) Explain different type of addressing modes used in PLC. [10]

Q.3
A) Design a controller for "controller canonical form" to yield 15% overshoot & a settling time of 0.5 second. The open loop transfer function of a plan is given by, $G(s) = \frac{10}{S(S+5)(S+10)}$. [10]

B) Consider a plant $G(s) = \frac{1}{S(S+3)(S+7)}$, whose state variables are not available. Design an observer for "observer canonical form" to yield transient response described by $\xi = 0.4$ *and* $W_n = 75$ rad/sec. [10]

Q.4
A) For a unit step, ramp and parabolic input .Find the steady state error for the system shown below, [10]



B) Given T(z) = N(z) / D(z), where $D(z) = z^3 - z^2 - 0.2z + 0.1$, use the Routh-Hurwitz criterion to find the number of z-plane poles of T(z) inside, outside and on the unit circle. Is the system stable? [10]

Q.5

A) Explain the timer instruction of PLC. And also explain the working principle of "OFF delay timer "T_{OFF}" with timing diagram. [10]

B) Explain the AC input module of PLC. [10]

Q.6

A) Explain integral windup and anti-windup circuits. [10]

B) Develop and explain a PLC ladder diagram for direction control of DC motor. [10]

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(3 Hours) **(Total Marks : 80)**

N.B. :

(1) **Question no: 1** is **Compulsory**.
(2) Solve **any three** questions out of **remaining**.
(3) Assume suitable **data** if **required** and **Specify the same**.

Q 1. Answer the following :- 20

a) Discuss various factors which affect breakdown of gases.
b) List out various test carried out on insulator.
c) Explain non-destructive testing of dielectric materials.
d) Explain the resonant transformer in detail.

Q.2 a) Derive an expression for voltage efficiency of a single stage impulse generator. 10
b) Discuss various method of measuring high dc and ac current. 10

Q.3 a) Explain clearly various process which explain electric breakdown in vacuum. 10
b) In an experiment in a certain gas it was found that the steady state current is $5.5 \times 10^{*}A$ at 8 KV at a distance of 0.4cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1cm results in a current of 5.5x10*A, Calculate Townsends's Primary Ionization coefficient. 10

Q.4a) Explain various test to be carried out on bushing. 10
b) Explain clearly the procedure for measurement of 1. Impulse 2. ac high voltages using sphere gap. 10

Q.5 a) Describe construction, principle and application of a multistage Marx's generator. 10
b) Define ripple voltage. Show that the ripple voltage in a rectifier circuit depends on load current and the circuit parameter. 10

Q.6 a) Write short note on:- H V Laboratory Layout ,grounding and Shielding. 10
b) Define and explain the following key terms in non-destructive testing techniques? 10

1) Discharge detectors
2) Loss factor
3) D.C. Resistivity
4) Bridge techniques
5) P.D. Measurements.

(3 Hours) **[Total Marks: 80]**

N.B.: 1. **Q.1 is compulsory**
2. Answer **any Three** out of remaining **Five** questions
3. Assume any suitable data wherever required but justify the same
4. Use graph paper wherever necessary

Q1 (A) Draw I-V (current v/s voltage) and P-V (power and voltage) characteristics of a solar PV panel at standard test conditions (STC). Clearly mark all essential parameters on the characteristics. Also show the impact of change in solar radiation (reduce to70% of STC) and operating temperature on its characteristics. **05**

(B) Draw the wind turbine characteristics. Explain the features of horizontal axis wind turbine and vertical axis wind turbine. **05**

(C) Explain the principles of Tidal and Wave Energy systems and their potential for electricity generation in India. **05**

(D) Illustrate the importance and role of renewable energy and energy storage systems in electrical power system. What are the types of alternative energy generation adopted by India? State their generation capacities. **05**

Q.2 (A) Describe how partial shading impacts the performance of a solar PV system? Describe the means and ways to minimize the effect of partial shading? **08**

(B) Illustrate the working principle of a Fuel cell with the help of its construction details and characteristics. State the different types of Fuel cells used in power generation. **06**

(C) Compare the performance of Solar PV, Fuel cell and WES as the renewable energy sources. **06**

Q.3 (A) Illustrate a typical single-phase AC stand-alone hybrid power generation system comprising solar PV source combined with fuel cell and ultra-capacitor bank. Determine the power capacity you would propose for each one of the sources if the net capacity of system is 10 kW and justify the same. Make necessary assumptions if needed. Explain role of each source in the system operation. **08**

(B) Draw the schematic of the following: **12**
(i) Power topology of a single-phase AC standalone solar PV system.
(ii) Power topology of a solar PV battery charging system for dc applications
(iii) Power topology of a Fuel cell fed three phase grid tied system

Q.4 (A) Compare the performance of flywheel, battery and ultra-capacitor as the energy storage components. State one application of each in existing energy scenario. **06**

(B) State and explain the following parameters of the batteries: SOC, DOD, C-rate and Energy efficiency. **08**

(C) Explain any one of the Maximum Power Point Tracking (MPPT) algorithm used in Solar PV system. **06**

Q.5 (A) Assume any suitable electrical daily load profile for any particular application. If a hybrid stand-alone system comprising solar PV and battery need to be used to provide the electrical supply to this assumed load, explain the selection and sizing of the solar PV panels and batteries. **10**

(B) Explain the principle of electrical power generation using biomass. **10**

Q.6 (A) Describe the role and importance of renewable energy and energy storage components in Smart-grid and Electric Vehicle applications. **10**

(B) Describe the electrical power generation with following technology in brief: **10**

(i) Ocean thermal energy system

(ii) Pumped hydro storage system

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