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Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058

End Semester Examination.

May 2017

Program: M. Tech Electrical Engineering **Date: 08/05/2017**

Course code: MTPX 121 **Duration: 4 hr.**

Maximum Marks: 100

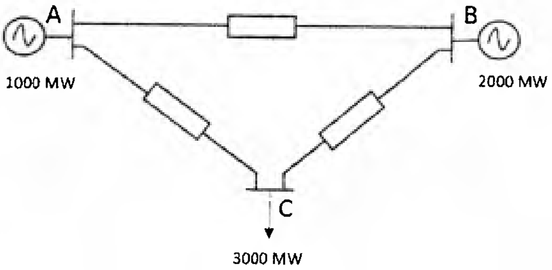
Name of the Course: Flexible AC Transmission **Semester: II**

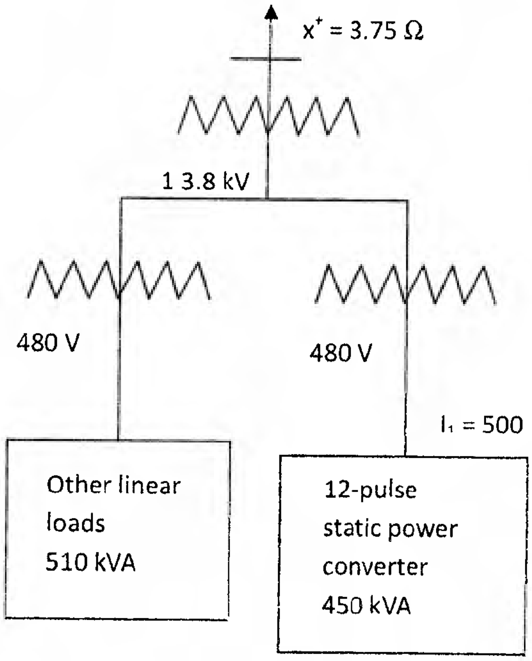
Master file.

Instructions:

- **(i) Question no. 1 is compulsory.**
- **(ii) Attempt any four from the remaining questions**
- **(iii) Assume suitable data if required.**

Q. No.	Description	Marks	C.O. No.	Module No.
Q. 1 a	What is the need of FACTS controllers in the power system?	05	1,2	1
Q. 1 b	Consider 3-Bus system connected with three lossless transmission lines AB, AC and BC with impedance 10Ω, 5Ω and 10Ω respectively and with continuous power rating of is 1000 MW, 1250 MW and 2000 MW respectively as shown in figure.1. Generators at Bus-A and Bus-B are generating 1000 MW and 2000 MW respectively to feed a load of 3000 MW at Bus-C. Calculate line flows. If any line is overloaded, suggest a solution to mitigate the same. (with calculations)	05	1,2	2

	 figure. 1			
Q. 1 c	State True or False: For a given MVA size, Series controller is more powerful than a Shunt controller. Justify the same.	05	2	3
Q. 1 d	What are the ways in which a FACTS device can be modeled in power system? Give an example for modeling any one FACTS device.	05	2	4
Q. 2 a	What are the Dynamic problems in A.C. power system? What are the mitigation methods of these problems by using FACTS devices?	10	1	1
Q. 2 b	What is the objective of Shunt compensation? Explain in detail how installed shunt compensation in the power system will be useful.	10	2	2
Q. 3 a	What is the principle of series compensation? Describe TCSC in detail.	10	2	2
Q. 3 b	Develop, design and explain the control strategies of compensator (any one) to improve power system stability.	10	2	4
Q. 4 a	What is Static synchronous compensation? Explain SSSC in detail. Also show how SSSC can reverse power flow.	10	2	3
Q. 4 b	What is the need of synchronization and co-ordination in UPFC? Explain UPFC in detail.	10	2	3

Q. 5 a	What are power quality problems? What is the cause of these problems?	10	2	5
Q. 5 b	A twelve pulse static power converter operates as a rectifier and it takes 450kVA from a 480 V bus as shown in the figure below. The driving point reactance at the point of common coupling (at 13.8 kV) is 3.75 Ω/phase. (i) Check this installation for compliance with IEEE Standard 519. (ii) By providing additional filter, the current THD of the converter is measured at 5.5% and the harmonic distortion is concentrated at the eleventh and thirteenth harmonics. Again check the installation for compliance with IEEE Standard 519.  	10	2	5
Q. 6 a	What are active filters and passive filters? What is the use of filters in mitigating the harmonics? Explain its design in detail.	10	2	6

Q. 6 b	Design control strategies for DSTATCOM for mitigation of harmonics in current.	10	2	6,7
Q. 7 a	What is the significance of S.C.R ratio in defining power quality standards? Also suggest the range of SCR ratio in which the load current described below is permitted as per IEEE Standard 519. The instantaneous current is given by $i_L = \sqrt{2}[100\sin(wt - 45^\circ) + 12\sin(5wt + 60^\circ) + 10\sin(7wt - 60^\circ) + 12\sin(10wt + 60^\circ)]$.	10	1,2	6,7
Q. 7 b	A sinusoidal voltage $e = 200\sqrt{2}\sin wt$ is applied to a nonlinear load resulting in a flow of current given by $i_L =$ $\sqrt{2}[20\sin(wt - 45^\circ) + 10\sin(2wt + 60^\circ)]$. Calculate the degree of power factor improvement realisable by the parallel connection of pure capacitance.	10	1	7

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Munshi Nagar, Andheri (West), Mumbai – 400058

End Sem Exam

May 2017

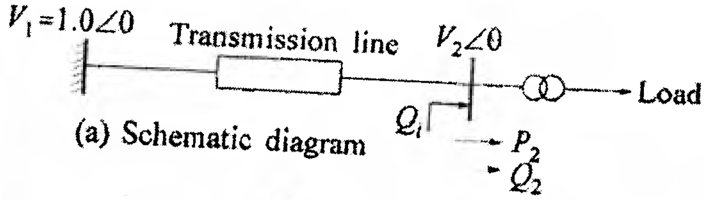
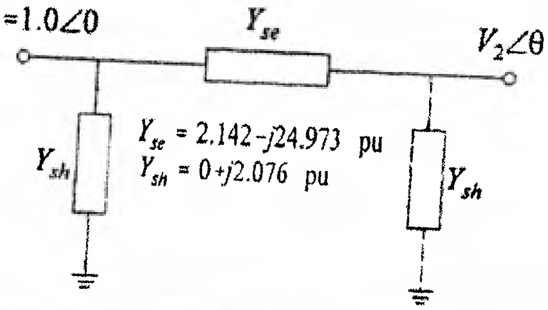
Program: M. Tech Electrical Engineering **Date:15/05/2017**
Course code: MTPX 123 **Duration: ~~3hr~~. 4 hrs.**
Maximum Marks:100

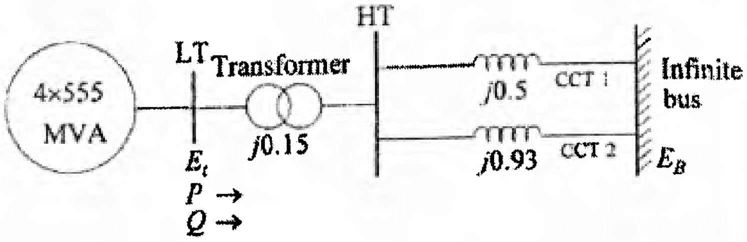
Name of the Course: Power System Dynamics and Control **Semester: II**

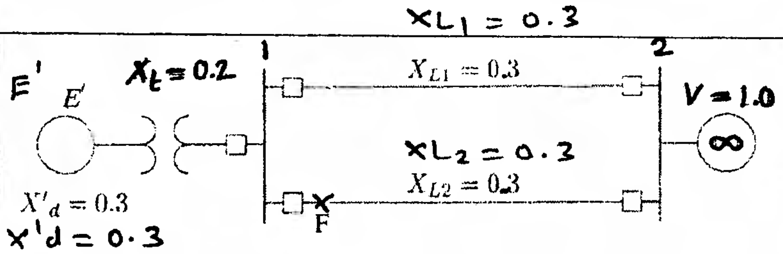
Instructions: (i) Question No 1 is Compulsory, Attempt Any Four Ques. From remaining Six questions.
(ii) Assume any data if required.

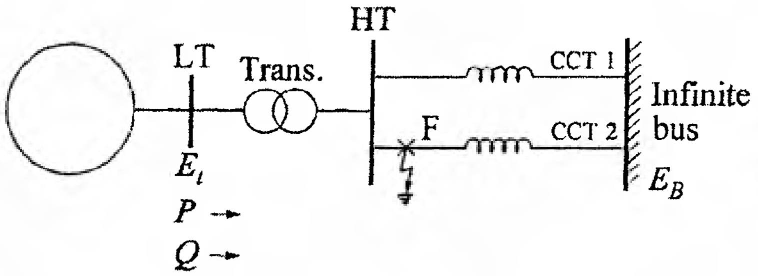
Master file .

Q. No.	Description	Marks	C.O.	Module
Q1.	(a) Explain in Brief the Load representation for Analyzing power system stability.	5	2	1
	(b) Explain in brief Rolling ball analogy and how it can be utilized for assessing transient stability?	5	1	3
	(c) Transform a two machine system to an equivalent SMIB System and how equal area criteria is applicable to it.	5	1	2
	(d) Explain PV and QV Curves in Voltage stability.	5	2	6
Q2.	Explain in detail the Effect of small disturbance on stability analysis of SMIB System.	20	1	1
Q3.	(a) Explain Equal area criteria, using this method illustrate how Sudden Change in Mechanical Input can be analyzed for SMIB System.	8	1,2	2
	(b) Figure below shows the system representation applicable to a 322 km, 400 kV transmission line supplying a radial load from a strong system. The line parameters are expressed in per unit on 100 MVA and 400 kV base. Write the equations of the power flow from the sending end to the receiving end. Find the expressions for	12	1,2	6

	$J_{P\theta}, J_{PV}, J_{Q\theta}, J_{QV}$ defined by the linearized load flow equations: Determine the voltage stability by computing the eigenvalues of the reduced Q- V Jacobian matrix for the following cases: (i) P = 1,500 MW, Qi = 450 MVAr, V_2 = 0 .0981, θ_2 = -39.1. (ii) P = 1,900 MW, Qi = 950 MVAr V_2 = 0 .0995, θ_2 = -52.97. Assume that the reactive power Qi is supplied by a shunt capacitor.  (a) Schematic diagram 			
Q4.	Figure below shows a thermal Power plant consisting of four 555 MVA, 24 kV, 50 Hz units. The network reactances shown in the figure are in per unit on 2220 MVA, 24 kV base (referred to the LT side of the step-up transformer). Resistances are assumed to be negligible. Analyze the small-signal stability characteristics of the system about the steady-state operating condition following the loss of circuit 2. The post fault system condition in per unit on the 2220 MVA, 24 kV base is as follows: P = 0.9, Q = 0.3 (over excited) $\tilde{E}_t = 1.0 \angle 36, \tilde{E}_t = 0.995\angle 0$. The generators are to be modelled as a single equivalent generator represented	20	2	4

	by the classical model with the following parameters expressed in per unit on 2220 MVA, 24 kV base: $X_d' = 0.3$, H = 3.5 MW's/MVA,  (a) Write the linearized state equations of the system. Determine the eigenvalues, damped frequency of oscillation in Hz, damping ratio and undammed natural frequency for each of the following values of damping coefficient (in pu torque/pu speed): (i) $K_D = 0$ (ii) $K_D = -20.0$ (iii) $K_D = 20.0$. (b) For the case with $K_D = 20.0$, find the left and right eigenvectors, and Participation matrix. Determine the time response if at ($t = 0$, $\Delta\delta = 5°$ and $\Delta\omega = 0$)			
Q5.	(a) Explain in Detail the effect of excitation system on small signal stability of single machine infinite bus system.	15	2	5
	(b) Explain in brief sensitivity analysis for voltage stability.	5	1,2	6
Q6.	(a) Find the Eigen values, Eigen vectors and participation factor of the system represented by state space model and whose state matrix is given as $A = \begin{bmatrix} 0 & -.1092 & -.1236 \\ 376.991 & 0 & 0 \\ 0 & -1938 & -.4229 \end{bmatrix}$	10	2	4
	(b) A 50 Hz Synchronous generator having Inertia constant H = 5 MJ/MVA and a direct axis transient reactance $X_d' =$ 0.3 per unit is connected to an infinite bus through a purely reactive circuit as shown in the fig below reactances are marked on the diagram on a common system base. The generator is delivering real power Pe = 0.8 pu, Q = 0.074 pu, to the infinite bus at a voltage of V = 1 pu,	10	1,2	2

<table>
<tr><td></td><td>

<p>(a) A 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 critical clearing time.</p>
<p>(b) A three phase fault occurs at the mid of one of the line the fault is cleared and faulted line is isolated, determine critical clearing angle.</p></td><td></td><td></td><td></td></tr>
<tr><td>Q. 7</td><td><p>(a) Consider a thermal generating station consisting of four 500 MVA, 24 kV, 50 Hz units supplying power to an infinite bus through two transmission circuits as shown in Figure below.</p>


<p>The network reactance's,</p>
<table>
<tr><th>Transformer</th><th>CCT-1</th><th>CCT-2</th></tr>
<tr><td>0.2j</td><td>0.5j</td><td>0.9j</td></tr>
</table>
<p>Shown in the table above are in per unit on 2000 MVA, 24 kV base (referred to the LT side of the step-up transformer). Resistances are assumed to be negligible. The initial system-operating condition, with quantities expressed in per unit on 2000 MVA and 24 kV base, is as follows: P = 0.8, Q = 0.5 (over excited) $\tilde{E}_t = 1.0 \angle 30, \tilde{E}_t = 0.85 \angle 0$,The generators are modelled as a single equivalent generator represented by the classical model with the following parameters expressed in per unit on 2220</p></td><td>10</td><td>1,2</td><td>3</td></tr>
</table>

	MVA, 24 kV base: X'_d= 0.35, H= 3.5 MW's/MVA, K_D = 0, Circuit 2 experiences a solid three-phase fault at point F, and the fault is cleared by isolating the faulted circuit. (a) Determine the value of critical clearing angle, using the equal-area criterion. (b) Using the TEF method for transient stability analysis. (i) Write the dynamic equations for the post disturbance system. (ii) Write the expression for the system energy function. (iii) Calculate the post disturbance system SEP, UEP, and the critical energy Vcr'. (iv) Calculate the energy at fault clearing with (a) tc = 0.07 s, θ_1^c = 48..58°(b) tc = 0.086 s, θ_1^c = 52.04°and (c) tc = 0.087 θ_1^c = 52.3° Analsyze the system stability for each of the three fault durations.			
	(b) Explain various methods of improving transient stability analysis.	10	2	7

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End Sem Exam

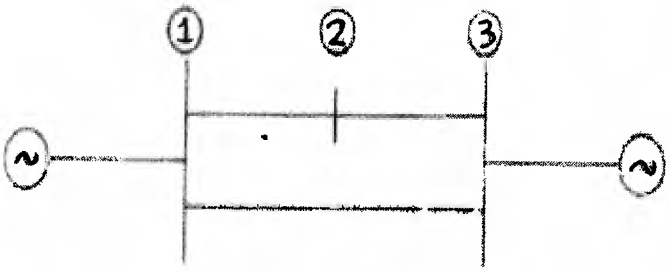
May 2017

Program: M. Tech Electrical Engineering **Date:17/05/2017**
Course code: MTPX 124 **Duration: ~~3 Hr.~~ 4 hrs**
Maximum Marks:100

Name of the Course: Computer Application of Power System. **Semester: II**

Instructions: (i) Question No 1 is Compulsory, Attempt Any Four Questions from remaining Six questions.
(ii) Assume any data if required.

Master file.

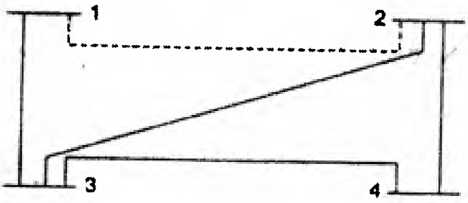
<table>
<tr><th>Q. No.</th><th>Description</th><th>Marks</th><th>C.O. No.</th><th>Module No.</th></tr>
<tr><td>Q1.</td><td>(a) For the power system network shown in Fig. below the primitive element data is as follows:
<table>
<tr><th rowspan="2">Element Number</th><th colspan="2">Bus Number</th><th rowspan="2">Primitive Impedance</th></tr>
<tr><th>From</th><th>To</th></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0.04</td></tr>
<tr><td>2</td><td>3</td><td>0</td><td>0.10</td></tr>
<tr><td>3</td><td>1</td><td>2</td><td>0.50</td></tr>
<tr><td>4</td><td>2</td><td>3</td><td>0.50</td></tr>
<tr><td>5</td><td>1</td><td>3</td><td>0.50</td></tr>
</table>


(i) Compute the Y_{bus} matrix assuming zero mutual coupling between the elements.
(ii) Compute the Y_{bus} matrix by taking a mutual coupling of 0.3 between elements 4 and 5.</td><td>5</td><td>1</td><td>1</td></tr>
<tr><td></td><td>(b) For the system shown in the figure below Generators are connected at all the four buses while loads are at bus 2 and 3. Values of real and reactive power are listed in table below all the buses except slack bus are PQ type. Assume flat voltage</td><td>5</td><td>1,2</td><td>2</td></tr>
</table>

start find voltage and bus angles at the three busses at the end of the first GS iteration.

$$Y_{Bus} = \begin{bmatrix} 3-9j & -2+6j & -1+3j & 0 \\ -2+6j & 3.66-11j & -.666+2j & -1+3j \\ -1+3j & -.666+2j & 3.66-11j & -2+6j \\ 0 & -1+3j & -2+6j & 3-9j \end{bmatrix}$$

Bus	P_i pu	Q_i pu	V_i pu	Remarks
1	-	-	$1.04\angle 0^0$	Slack Bus
2	0.5	-0.2	-	PQ Bus
3	-1.0	0.5	-	PQ Bus
4	0.3	-0.1	-	PQ Bus



(c) Using the method of Triangular Factorization obtain the table of factors for matrix below.

$$\begin{bmatrix} 11 & 17 & 18 & 16 \\ 23 & 27 & 25 & 28 \\ 22 & 32 & 34 & 36 \\ 12 & 15 & 41 & 36 \end{bmatrix}$$

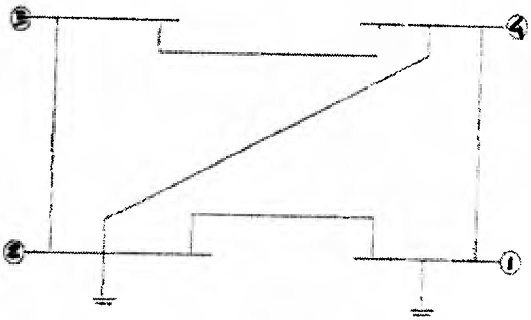
5 2 3

(d) A system consist of 4 Identical 250 MVA Generators Feeding a Load of 510 MW. The Inertia constant of each machine is 3.0 on the machine base. The load varies by 1.4% for a 1 % change in frequency. If there is drop of 10 MW, Determine the system block diagram expressing H and D on a base of 1000 MVA. Give expression for the speed deviation assuming there is no speed governor.

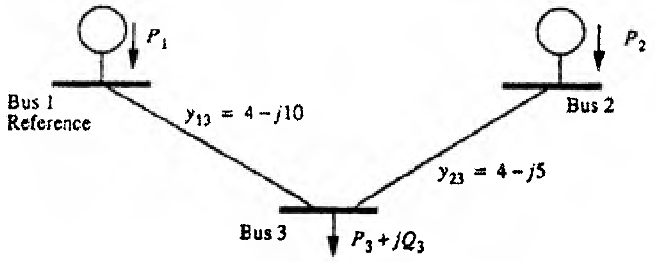
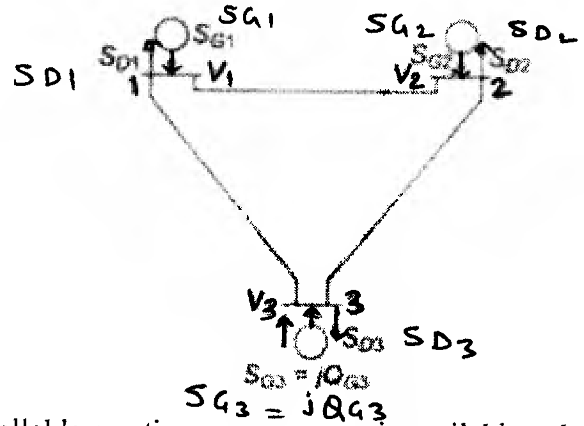
5 2 6

Q2. Using [Z_{Bus}] matrix building algorithm for the network shown in the figure below obtain [Z_{Bus}] matrix.

20 2 1



Element Number	Bus Number		Impedance
	From	To	
1	1	0	0.1j
2	2	0	0.1j
3	1	2	0.2j
4	2	3	0.3j
5	3	4	0.15j

<table>
<tr><td></td><td><table><tr><td>6</td><td>1</td><td>4</td><td>0.25j</td></tr><tr><td>7</td><td>2</td><td>4</td><td>0.15j</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>Q3.</td><td>(a) Perform the load flow technique using Newton Raphson technique on the three-bus AC system in Figure below, also calculate losses in the lines and total losses.

$P_3 + j\,Q_3 = 2.1 + j\,1.1$ per unit, $P_2 = 1.8$ per unit.</td><td>10</td><td>1,2</td><td>2</td></tr>
<tr><td></td><td>(b) Consider a three bus system of figure below, each of the three lines has a series impedance of 0.02 + j0.08 pu and total shunt impedance of j0.02 pu. The specified quantities at the buses are tabulated below.
<table><tr><td>Bus</td><td>Real Load Demand P_D</td><td>Real Load Demand Q_D</td><td>Real Power Generation P_G</td><td>Real Power Generation P_G</td><td>Voltage Specification</td></tr><tr><td>1</td><td>2.0</td><td>1.0</td><td>Unspecified</td><td>Unspecified</td><td>$V_1 = 1.04 + j0$ Slack Bus</td></tr><tr><td>2</td><td>0.0</td><td>0.0</td><td>0.5</td><td>1.0</td><td>Unspecified PQ bus</td></tr><tr><td>3</td><td>1.5</td><td>0.6</td><td>0.0</td><td>$Q_{G3} = ?$</td><td>$V_3 = 1.04$ (PV Bus)</td></tr></table>

Controllable reactive power source is available at bus 3 with constraint $0 \leq Q_{G3} \leq 1.5$ pu.
Using (a) Decoupled NR method (b) FDLF Method to obtain one iteration of the load flow solution.</td><td>10</td><td>1,2</td><td>2</td></tr>
<tr><td>Q4.</td><td>Using Network given in the Q3 (a), above show that losses how losses can be minimized using Optimal Load Flow Technique also calculate that new loss figure and compare the results, take α = 0.03.</td><td>20</td><td>1,2</td><td>3</td></tr>
<tr><td>Q5.</td><td>(a) The Single line diagram of the simple power system is shown in the figure below, the neutral of each Generator is grounded through a current limiting reactor of 0.25/3 per unit on a 100 MVA base. The system data expressed in per unit on</td><td>20</td><td>1,2</td><td>4</td></tr>
</table>

a 100 MVA base. The system data on 100 MVA base have been tabulated below, The Generators are running on no-load at their rated voltage and rated frequency with tier emf in phase. Determine the Fault current, Bus Voltage and Line Current using bus Impedance Matrix Method.

(a) A Balanced three phase fault at bus 3 through a fault impedance of 0.15 j per unit

(d) A Single line to Ground fault at bus 3 through a fault impedance of 0.15 j per unit.

(d) A Line to Line fault at bus 3 through a fault impedance of 0.15 j per unit.

(d) A Double line to Ground fault at bus 3 through a fault impedance of 0.15 j per unit.

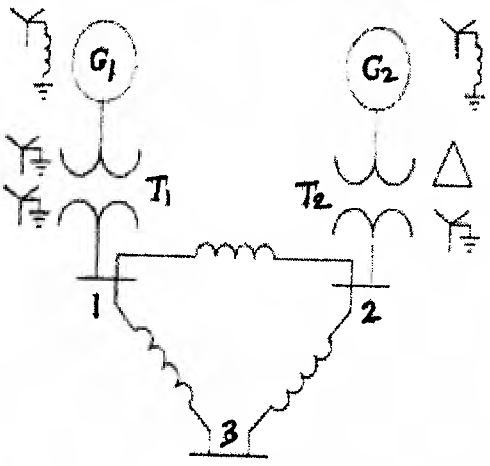
Item	Base MVA	Voltage Rating	X_1	X_2	X_0
G1	100	20 kV	0.15	0.15	0.05
G1	100	20 kV	0.15	0.15	0.05
T1	100	20/220 kV	0.125	0.125	0.125
T2	100	20/220 kV	0.125	0.125	0.125
L12	100	220 kV	0.125	0.125	0.30
L13	100	220 kV	0.15	0.15	0.35
L23	100	220 kV	0.25	0.25	0.7125

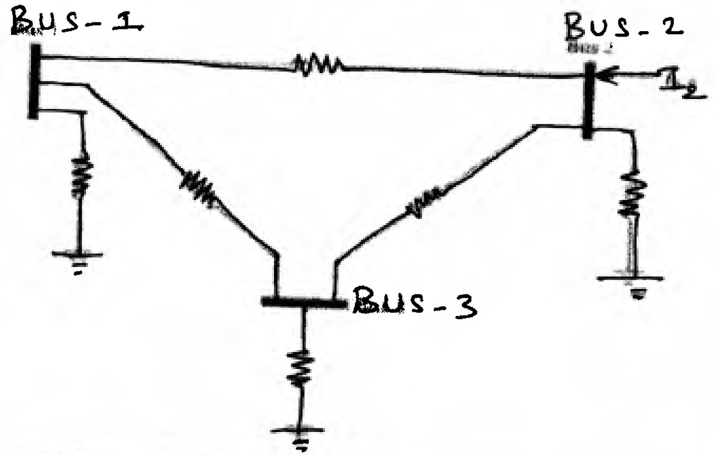
The Positive Sequence Matrix is given by

$$Z_{bus}^{1}\begin{bmatrix} j0.1450 & j0.1450 & j0.1300 \\ j0.1050 & j0.1450 & j0.1200 \\ j0.1300 & j0.1200 & j0.2200 \end{bmatrix}$$

The Zero Sequence Matrix is given by

$$Z_{bus}^{0}\begin{bmatrix} j0.1820 & j0.0545 & j0.1400 \\ j0.0545 & j0.0864 & j0.0650 \\ j0.1400 & j0.0650 & j0.3500 \end{bmatrix}$$



<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Q6.</td><td>(a) Utilizing the data of question no 3 above using thevnin method Determine the Fault current for the following faults.
(a) A Balanced three phase fault at bus 3 through a fault impedance of 0.15 j per unit
(b) A Single line to Ground fault at bus 3 through a fault impedance of 0.15 j per unit
(c) A Line to Line fault at bus 3 through a fault impedance of 0.15 j per unit
(d) A Double line to Ground fault at bus 3 through a fault impedance of 0.15 j per unit.</td><td>10</td><td>1,2</td><td>4</td></tr>
<tr><td></td><td>(b) Find the optimal water discharge of the hydro plant, in a hydrothermal system where the load varies in 8 hour intervals as 6 MW 9 M W and 12 MW. There is no water inflow into the reservoir. The transmission losses can be neglected. The initial water storage is 130 m³/s and the final water storage is 80 m³/s. The basic head is 25 m. The head correction factor e = 0.005 and non-effective water discharge is 3 m³/s. The incremental fuel cost of the thermal plant is given by</td><td>10</td><td>1</td><td>6</td></tr>
<tr><td>Q7.</td><td>In the network shown in the figure below a unit current is injected into bus 2 to establish the initial voltage distribution. Calculate the effect of an open circuit of the line from Bus 1 to bus 2. Branch Resistance are as follows.
<table>
<tr><th rowspan="2">Element Number</th><th colspan="2">Bus Number</th><th rowspan="2">Resistances</th></tr>
<tr><th>From</th><th>To</th></tr>
<tr><td>1</td><td>1</td><td>2</td><td>1</td></tr>
<tr><td>2</td><td>1</td><td>3</td><td>1</td></tr>
<tr><td>3</td><td>2</td><td>3</td><td>1</td></tr>
<tr><td>4</td><td>1</td><td>0</td><td>2</td></tr>
<tr><td>5</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>6</td><td>3</td><td>0</td><td>2</td></tr>
</table>
Injected current I₂ as 1 pu.

</td><td>20</td><td>2</td><td>5</td></tr>
</table>

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End Semester

May 2017

Program: M. Tech Electrical Engineering **Date: 19 ~~20~~/05/2017**

Course code: MTPX 128 **Duration: 3 ~~4~~hr.**

Maximum Marks: 100

Name of the Course: Application of Power Electronics in Renewable Energy System

Semester: II

Master file.

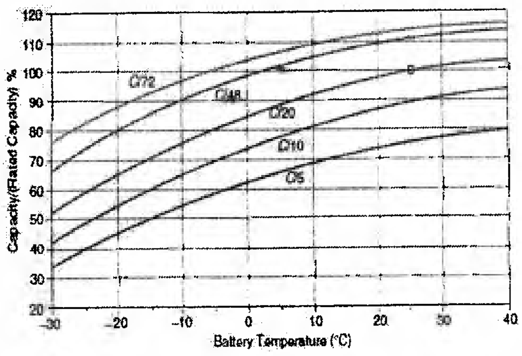
Instructions: (i) Question number One is Compulsory

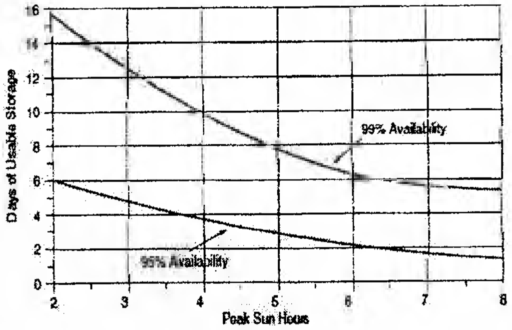
(ii) Attempt Four out of the remaining Six Questions

(iii) Assume any data if required.

Q. No.	Description	Marks	C.O. No.	Module No.
Q. 1	Solve any 4 out of the following 6 questions.			
	a) What are the environmental effects of using conventional energy sources?	5	1	1
	b) What is a Reference Frame Transformation and why is it useful in analysing electrical machine operation?	5	2	2
	c) Draw and Explain the Electrical model of a PV Cell	5	3	3
	d) Draw the schematic of Type-4 Wind Turbine System and explain its salient features	5	2	4
	e) Why is maximum power point tracking required for a PV System. Explain using P-V & I-V curves	5	3	5
	f) Give the different topologies of a stand alone Hybrid Renewable Energy Systems	5	4	7
Q. 2	a) Explain Geothermal and Fuel Cell technologies as renewable energy sources	10	1	1
	b) For a Standalone size the battery and PV array for a 99% available system. The Solar Insolation is 3 kWh/m^2-day and the temperature is -15 °C for December. The AC load is 5000 Wh/day with a 96%	10	3	2

efficient inverter. Use the following graphs for battery sizing (The battery size is 250 A-h at 20 °C and C/20 rate of discharge)





Use the following table for PV array sizing

Shell SPI 150	
Material	Monocrystal
Rated Power	150 W
Vmp	34 V
Imp	4.4 A
Voc	43.4 V
Isc	4.8 A
Length	1.619 m
Breadth	0.814 m
Efficiency	11.40%

Q.3	a) Derive the voltage relationship for a buck converter with neatly labelled graphs, and find out the condition for its Continuous Conduction Mode	10	3	3
	b) Derive the small signal model of Buck converter using Circuit Averaging and State Space Representation	10	3	3

Q.4	a) Explain the control of Grid Connected PV Inverter b) Give the algorithm for Incremental Conductance MPPT for Solar PV also develop a MATLAB Function for the same	10 10	3 3	5 5
Q.5	a) Explain the concept of MPPT in wind turbines and describe the Yaw and Pitch Control mechanisms b) Explain the vectrol control strategy used for DFIG	10 10	2 2	4 4
Q.6	a) Explain the grid integration problems of solar and wind energy systems b) Describe the Flow Battery system and Pumped Hydro system as utility level storage technologies	10 10	2,3 2,3	6 6
Q.7	a) Compare the different Coupling mechanisms used for Hybrid Renewable system integration, with neat schematics b) Explain the power converters and controls used in a PV+Wind+Battery hybrid energy system	10 10	4 4	7 7

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Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058

End Semester Examination.

May 2017

Program: M. Tech **Electrical Engineering** **Date: 22/05/2017**

Course code: **MTPX 122** **Duration:** 4 hr.

Maximum Marks: 100

Name of the Course: Advanced Control of Electrical Drives **Semester:** II

Master file.

Instructions:
- **(i) Question no. 1 is compulsory.**
- **(ii) Attempt any four from the remaining questions**
- **(iii)Assume suitable data if required.**

Q. No.	Description	Marks	C.O. No.	Module No.
Q. 1 a	What is the status of A.C and D.C drives on the basis of usage, capacity, and advancement in power electronics, etc?	5	1	1
Q. 1 b	Give any five applications of Electrical drives. Select a specific drive of each of them. Give justification for the same.	5	1,2	1,3,4,5
Q. 1 c	What do you understand by slip gain tuning? What is its significance? How it is achieved?	5	5	5
Q. 1 d	Suggest any method to provide brushless D.C. Excitation of Synchronous motor.	5	1,4	7
Q. 2 a	With the Principles of phase control theory explain single phase half-controlled rectifier control and three phase fully controlled rectifier control of separately excited motor.	10	2,3	2

Q. 2 b	A 200 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06 Ω and inductance of 0.8 mH. It is fed from a single phase fully-controlled rectifier with an ac source voltage of 220 V, 50 Hz. Calculate (i) Motor torque for ∝ = 65° and speed = 400 rpm. Note : Use the details for w_{mc}, K and β if necessary $w_{mc} = \frac{R_a V_m}{ZK} \sin(\alpha - \emptyset) \left[\frac{1 + e^{-\pi \cot \emptyset}}{e^{-\pi \cot \emptyset} - 1}\right]$ $K = \frac{E}{w_m}$; $\beta = 230$ (ii) If the drive is found in discontinuous conduction mode, suggest a solution to the region of discontinuous conduction. With calculations prove the same.	10	3,4	2
Q. 3 a	Develop a state space model and time block diagram of shunt connected dc machine and calculate steady state speed of the motor for the parameters given below : The parameters of a dc shunt machine are R_f=240Ω, L_{ff}=120H, L_{af}=1.8H, r_a= 0.6Ω, L_{aa}=0. The load torque is 5 N.m and $V_a = V_f = 240$V.	10	3	3
Q. 3 b	Explain Closed loop control of Chopper fed D.C. drive.	05	3	3
Q. 3 c	For a chopper fed 230V, 960 rpm, 200 A separately excited D.C. motor with armature resistance 0.02Ω, calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm.	05	3	3
Q. 4 a	What is the significance of V/f ratio for speed control of induction motor? What are its limitations that can be eliminated by providing torque and flux control? Explain closed loop speed control with torque and flux control of induction motor	10	4	4

Q. 4 b	What are the benefits of using Current-Fed Inverter Control for speed control of induction motor. Explain the same with the block diagram.	10	4	4
Q. 5 a	A Y-connected squirrel-cage induction motor has following rating and parameters: 400V,50 Hz, 4-pole,1370 rpm, R_s =2Ω, R_r' =3Ω, $X_s = X_r'$ =3.5 Ω, X_m =55 Ω. It is controlled by a current source inverter at a constant flux. Calculate motor torque, speed and stator current when operating at 40 Hz and rated slip speed.	10	4	4
Q. 5 b	Is Direct Torque Control (DTC) scalar method /vector method of speed control of induction motor? Why? Explain control strategy and method for estimating flux in DTC.	10	3,4	6
Q. 6 a	Explain Direct vector control method of speed control of Induction motor. Give a detailed method for estimating flux in this method	10	5	5
Q. 6 b	Compare stator oriented flux control and rotor oriented flux control. Drawbacks of each and solution methods to overcome these drawbacks	10	5	5
Q. 7 a	A Space Vector PWM VSI, having a DC supply of 400 V and a switching frequency of 2.5kHz, is required to synthesize voltage V_s^* = $210\angle 200\,°$ V. Calculate the time of switching of the space vectors. Also draw the sequence of switching.	10	5	2
Q. 7 b	What is the basic difference between the Vector control of induction motor and vector control of synchronous motor? Why Absolute position encoders are required for speed control of synchronous motor? Explain open loop Volts/Hertz control of sinusoidal SPM machine drives	10	5	5,7

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Re-Examination.

June 2017

Program: M. Tech Electrical Engineering **Date: 19/06/2017**

Course code: MTPX 121 **Duration: 4 hr.**

Maximum Marks: 100

Name of the Course: Flexible AC Transmission **Semester: II**

Master file.

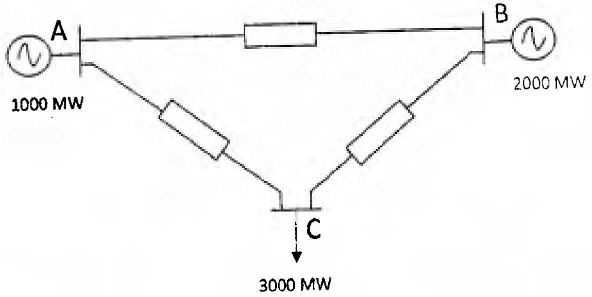
Instructions:

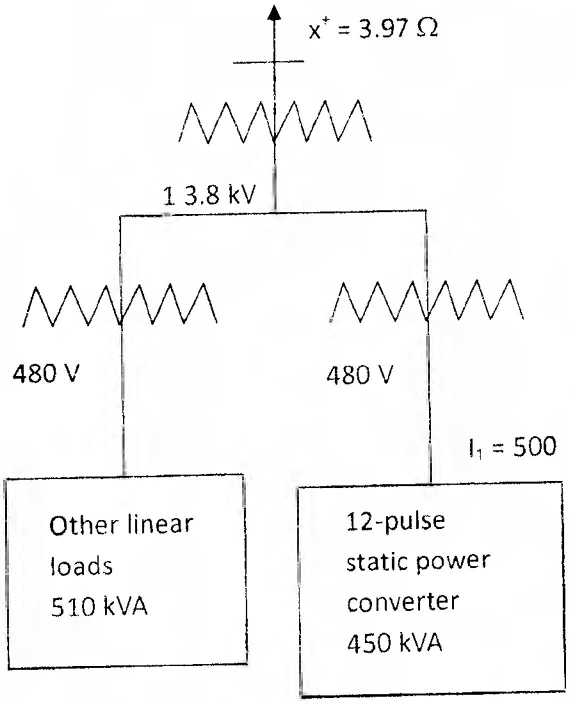
(i) **Question no. 1 is compulsory.**

(ii) **Attempt any four from the remaining questions**

(iii) **Assume suitable data if required.**

Q. No.	**Description**	**Marks**	**C.O. No.**	**Module No.**
Q. 1 a	What are the advantages of using the FACTS controllers ?	05	1,2	1
Q. 1 b	Consider 3-Bus system connected with three lossless transmission lines AB, AC and BC with impedance 10Ω, 5Ω and 10Ω respectively and with continuous power rating of is 1000 MW, 1250 MW and 2000 MW respectively as shown in figure.1. Generators at Bus-A and Bus-B are generating 1000 MW and 2000 MW respectively to feed a load of 3000 MW at Bus-C. Calculate line flows. If any line is overloaded, suggest a solution to mitigate the same. (with calculations)	05	1,2	2

	 figure. 1			
Q. 1 c	Describe the conditions wherein Shunt FACTS controller is more suitable than Series FACTS controller.	05	2	3
Q. 1 d	How Shunt FACTS controller can be modeled in Power System?	05	2	4
Q. 2 a	What are Power Oscillations? What are its mitigation methods by using FACTS devices?	10	1	1
Q. 2 b	What is the objective of Shunt compensation? Explain in detail how installed shunt compensation in the power system will be useful.	10	2	2
Q. 3 a	What is Thyristor Controlled Series Compensator (TCSC)? Give a brief description of the same.	10	2	2
Q. 3 b	Develop, design and explain the control strategies of compensator (any one) to improve power system stability.	10	2	4
Q. 4 a	What is Static synchronous compensation? Explain SSSC in detail.	10	2	3
Q. 4 b	What are the benefits of using UPFC in power system? Give a brief description of the same.	10	2	3

Q. 5 a	What are power quality issues? What is the reason behind these problems?	10	2	5
Q. 5 b	A twelve pulse static power converter operates as a rectifier and it takes 450kVA from a 480 V bus as shown in the figure below. The driving point reactance at the point of common coupling (at 13.8 kV) is 3.97 Ω/phase. Check this installation for compliance with IEEE Standard 519. 	10	2	5
Q. 6 a	What are active filters and passive filters? What is the use of filters in mitigating the harmonics?	10	2	6
Q. 6 b	Design control strategies for DSTATCOM for mitigation of harmonics in current.	10	2	6,7
Q. 7 a	What is the significance of S.C.R ratio in defining power quality standards? Also suggest the range of SCR ratio in which the load current described below is permitted as per IEEE Standard 519.	10	1,2	6,7

	The instantaneous current is given by $i_L = \sqrt{2}[100\sin(wt - 45^\circ)$ $+ 12\sin(5wt + 60^\circ)$ $+ 10\sin(7wt - 60^\circ)$ $+ 12\sin(10wt + 60^\circ)]$.			
Q. 7 b	A sinusoidal voltage $e = 200\sqrt{2}\sin wt$ is applied to a nonlinear load resulting in a flow of current given by $i_L =$ $\sqrt{2}[20\sin(wt - 45^\circ) + 10\sin(2wt + 60^\circ)]$. Calculate the degree of power factor improvement realisable by the parallel connection of pure capacitance.	10	1	7