S6 EEE
ALL SUBJECT QUESTION BANK
EET302 LINEAR CONTROL SYSTEMS

Module 1

Sl No.	Questions	Marks	KU/ KTU (Month/ Year)
1	Give a comparison between penloop &closed loop control systems	5	KTUDec2017
2	Obtain the force voltage analogy of a general mechanical translation system.	5	KTUDec2017
4	Obtain the transfer function of an armature controlled DC motor.	5	KTUDec2017
5	Derive the closed loop transfer function for a non-unity feedback system.	5	KTUDec2018
6	Explain the features and control applications of Tacho generators.	4	KTU Sep2020
7	Derive the transfer function of the Field controlled DC servo motor and hence explain the system characteristics?	6	KTU Sep2020
8	How does an automatic control system differ from an open loop system? Mention at least four general control system components required for the modification?	4	KTU Sep2020
9	Explain the constructional features and principle of operation of a synchro? What are the advantages of a stepper motor? List two applications of the stepper motor?	10	KTUMay2019
10	With relevant characteristics, explain the applications of synchro transmitter and receiver units?	5	KTU Sep2020
11	Derive the closed loop transfer function for a non-unity feedback system.	5	KTUDec2018

Module 2			
Sl No.	**Questions**	**Marks**	**KU/ KTU (Month/ Year)**
1	Obtain the unit step response of the first order system?	5	KTUDec2019
2	What are the standard test signals used for time domain analysis?	4	KTUDec2019
3	Derive the expression for maximum peak overshoot, rise time and peak time of a second order system for a step input?	6	KTUDec2019
4	A unity feedback system is characterized by an open loop transfer function $G_p(s)=\frac{20}{s^2+5s+5}$. Determine the transient response when subjected to a unit step input and sketch the response. Evaluate the maximum overshoot and the corresponding peak time of the system.	5	KTUDec2018
5	Derive the closed loop transfer function for a non-unity feedback system.	5	KTUDec2018
6	Derive an expression for the step response of a critically damped second order system?	4	KTUDec2018
7	Determine the value of gain K and the natural frequency of oscillation ωn for the unity feedback system with forward transfer function $G_p(s)=\frac{K}{s(s+10)}$ which results in a critically damped response when subjected to a unit step input.	6	KTUDec2018
9	Sketch the unit step response of an under damped second order system and mark various time domain specifications.	3	KTUApril2 01 8
10	Derive an expression for peak time and settling time of an under damped second order system. A unity feedback control system is characterized by an open loop transfer function $G(s)=\frac{K}{s(s+10)}$ Determine the gain K so that the system will have a damping ratio of 0.5	10	KTUApril2 01 8
11	Determine the unit step response for the system with transfer function $T(s)=\frac{1}{(s^2+4s+5)}$. Also determine peak overshoot (Mp) and peak time (tp).	6	KTU Sep2020

12	A unity feedback system has a open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$. Determine the steady state error for unit step input.	5	KTUDec2017
13	(a) For a unity feedback control system with the open loop transfer function 1 (S) / s (s+5) GFind the position, velocity and acceleration error coefficients. (b)Using Routh-Hurwitz criterion determine the relation between *K* and *T* so that unity feedback control system having characteristic equation G s( ) s + 2s + 4s + 8s + 16s + 32	10	KTUDec2017
14	(a)Consider a unity feedback system with an open loop transfer function *k/s(s*+20). Determine the value K which would result in a steady state error of 0.05 for a unit ramp input. (b) Using Routh-Hurwitz criterion determine the value of K for which the closed loop system transfer function 20 (s)/ (s + 5 s + 5) is stable, marginally stable and unstable	10	KTU DEC 2021

Module 3			
Sl No.	**Questions**	**Marks**	**KU/ KTU**
			(Month/ Year)
1	What is the angle criterion referred to as the root locus?	5	KTUDec2017
2	Explain the effect of addition of poles and zeros on the nature of root locus. Sketch the root locus for the open loop transfer function of a unity feedback system given below,	10	KTUDec2017
3	(a)What is a root locus? What is the information obtained from a root locus? (b)Explain the effect of adding a pole to a system on time response.	8	KTUApr2018
4	Sketch root locus for a system with 20 (s)/ (s + 5 s + 5) having unity feedback system Hence determine the range of K for the system stability.	10	KTUApr2018

5	What is magnitude and angle criterion? Determine whether the points (-4+j2) is on the root locus of a unity feedback system with forward transfer function G(S)= K (S)/ s(s + 20 s + 8)	5	KTUDec2018
6	Ascertain stability of the system whose characteristic equation is s + 2s + 4s + 8s + 16s + 32; Also find the number of roots lying on the left half, right half and imaginary axis of the s-plane.	10	KTUApril2018
7	Check the stability of the system given by the characteristic equation s + 2s + 4s + 8s + 16s + 32;	5	KTUDec2018
8	(a)Consider a unity feedback system with an open loop transfer function $k/s(s+20)$. Determine the value K which would result in a steady state error of 0.05 for a unit ramp input. (b) Using Routh-Hurwitz criterion determine the value of K for which the closed loop system transfer function is stable, marginally stable and unstable.	10	KTUDec2018
9	Determine the dynamic error coefficients for a unity feedback system whose open loop transfer function is 20/s(s+10) when subjected to an input of G(S)= K (S)/ s(s + 20 s + 8)Also compute the steady state error of the system.	6	KTUDec2018

10	(a)What is a root locus? What is the information obtained from a root locus? (b)Explain the effect of adding a pole to a system on time response.	8	KTUApr2018
11	Discuss about the effect of addition of poles and zeros to the open-loop transfer function G(s) H(s) on the root locus.	4	KTUDec2018, 2019
12	Explain important rules for root locus?	4	KTUDec2019
13	How do you determine the angle of departure of the root locus branch from an open loop pole, using angle criterion?	5	KTU Sep2020

Module 4			
Sl No.	**Questions**	**Marks**	**KU/KTU** **(Month/ Year)**
1	(a)Define any three frequency response specifications used for the design of the control system? (b)Explain how the stability of a system is analyzed using a Bode plot?	10	KTUDec 2018
2	The open-loop transfer function of a unity feedback system is	10	KTUDec 2018
3	Derive an expression for resonant frequency and resonant peak of a second order system.	5	KTUApril 2018
4	Construct bode plot for the system whose open loop transfer function is G(S)H(S)=K/(S+4)Determine the following: i) Gain margin ii) Phase margin iii) Closed loop stability	10	KTUApril 2018
5	Determine the phase cross over frequency of a system with open loop transfer function K/(S+2)	10	KTUDec 2017
6	(a)Explain any three frequency domain specifications of a control system. (b)The open loop transfer function of system is given by G(S)=[6/(S+1)(S+2)] Draw the bode plot and obtain the gain and phase crossover frequencies.	10	KTUDec 2017
7	Define the phase cross over frequency and gain cross over frequency of a system.	5	KTUDec2017
8	Explain Gain margin and Phase margin of a system.	5	KTUApril2018, Dec 2017,2019
9	Find the value of open loop gain k for G(s)H(s)= [K/(S(05S+1)(0.04S+1) so that the system has a) phase margin of 10dB) gain margin 15 dB using Bode plot	10	KTUDec 2019
10	Derive and explain the dependence of damping factor on the resonant peak (Mr) of a second order system?	5	KTU Sep2020
11	Explain the significance of gain crossover frequency and phase cross over frequency in the system performance with suitable characteristics.	5	KTU Sep2020

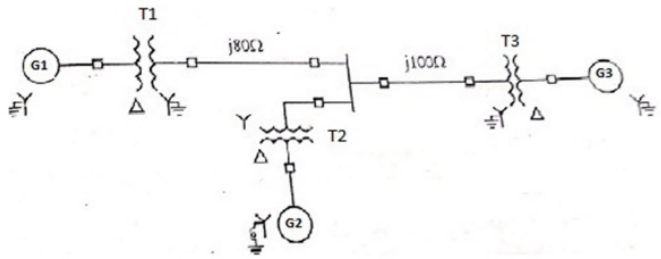
12	Determine the value of K such that the system with open loop transfer function G(S)=[6/(S+1)(S+2)] is marginally stable, using the Bode plot.	10	KTU Sep2020
13	With suitable characteristics explain the effects of Transportation lag(e^{-sT}) on Bode plot	5	KTU Sep2020

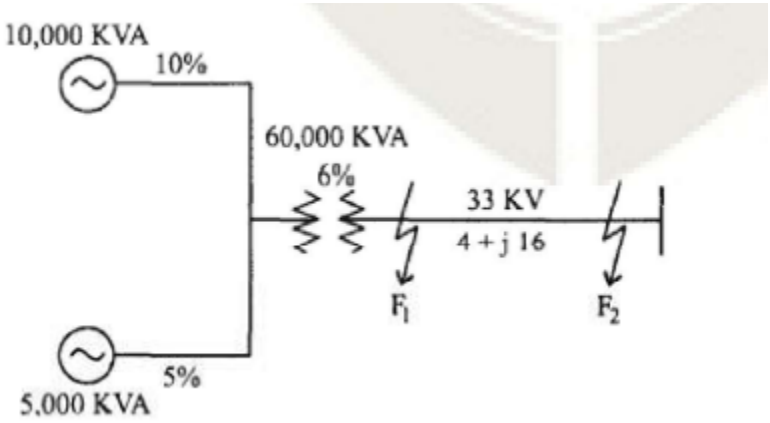
Module 5			
Sl No.	**Questions**	**Marks**	**KU/KTU (Month/ Year)**
1	State and explain Nyquist stability criterion	5	KTUApril, Dec2018,2017
2	Differentiate between minimum phase and non-minimum phase systems with suitable examples.	5	KTUDec 2017
3	Sketch the polar plot of a unity feedback control system having an open loop transfer function Also determine the value of K so that: i) Gain margin is 20dB ii)Phase margin is 30	10	KTUApr2018
4	Draw Nyquist plot for the system whose open loop transfer function G(S)H(S)= K/[S(S+2)(S+10)] Determine the range of K for which the closed loop system is stable	10	KTUApr2018
5	(a)Test the stability using Nyquist criterion, for the system with open loop transfer function G(S)H(S)= K/[S(S+2)(S+10)] (b)Compare between non minimum phase systems and minimum phase systems?	10	KTU Sep2020
6	Explain the salient features and advantages of Nichols chart in Control system design.	5	KTU Sep2020
7	State and explain Nyquist stability criterion?	5	KTU Sep2020
8	Obtain the polar plot and hence determine the value of K such that the system with open loop transfer function G(s)=K/s (s + 1)(s + 4) is marginally stable?	5	KTU Sep2020

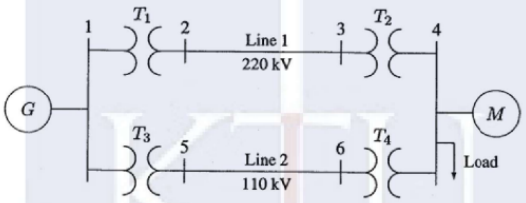
QUESTION BANK

Subject: Power system II (EET 304)

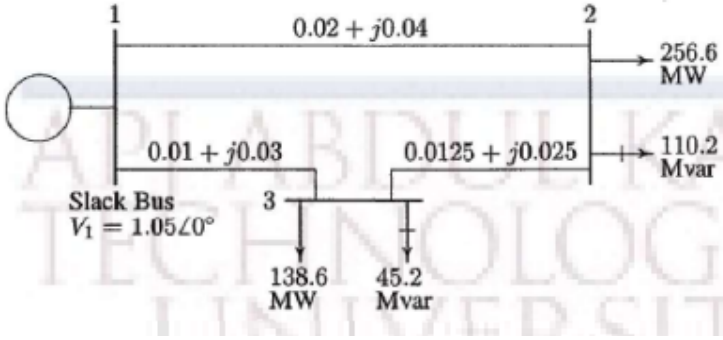
S6 EEE

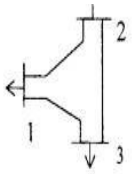
Sl No.	Question	Marks	
	Module 1		
1	The generator neutral grounding impedance appears as 3Zn in the zero-sequence network. Why?	3	Model QP
2	The single line diagram of an unloaded power system is shown in the figure. The generator and transformer are rated as: G1= 20MVA, 13.8kV, X"=20%; G2=30MVA, 18kV, X"=20%; G3=30MVA,20kV, X" =20%; T1=25MVA,220/13.8kV, X=10%, T2=3 single-phase units each rated at 10MVA, 127/18kV, X=10%, T3=35MVA, 220/22kV, X=10%. Draw the reactance diagram using a base of 50 MVA and 13.8kV on generator G1. 	10	KTU (JULY 2021)
3	Draw the zero sequence, negative sequence, and positive sequence network of a generator grounded through a reactance	4	KTU (JULY 2021)
4	A 30 MVA, 13.8 KV, 3-phase generator has a sub transient reactance of 15%. The generator supplies 2 motors through a step-up transformer - transmission line – step-down transformer arrangement. The motors have rated inputs of 20 MVA and 10 MVA at 12.8 KV with 20% sub transient reactance each. The 3-phase transformers are rated at 35 MVA, 13.2 KV -Δ /115 KV-Y with 10 % leakage reactance. The line reactance is 80 ohms. Draw the equivalent per unit reactance diagram by selecting the generator ratings as base values in the generator circuit.	10	KTU (SEP 2020)

5	Derive the expression for fault current for a single line to a ground fault occurring in an unloaded generator. Also, draw the interconnection of sequence networks.	6	KTU (JULY 2021)
6	The symmetrical components of phase voltages in a 3-phase unbalanced system are Va0=10∠1800 V, Va1=50∠0 0 V and Va2=20∠900 V. Determine the phase voltages Va, Vb, and Vc	6	KTU (DEC 2019)
7	A 33 KV line has a resistance of 4 ohm and reactance of 16 ohm respectively. The line is connected to a generating station bus bar through a 6000 KVA step-up transformer which has a reactance of 6%. The station has two generators rated 10,000 KVA with 10% reactance and 5000 KVA with 5% reactance. Calculate the fault current and short circuit KVA when a 3-phase fault occurs at the HV terminals of the transformers and at the load end of the line. 	10	Model QP
8	The one-line diagram of a three-phase power system is shown in figure below. Select the common base of 100 MVA and 22 kV on the generator side. Draw an impedance diagram with all impedances including the load impedance marked in per unit. The manufacturer's data for each device is given as follows. The three-phase load at bus 4 absorbs 57 MVA, .6 power factor lagging at 10.45 kV. Line1 and Line 2 have reactances of 48.4 ohm and 65.3 ohm respectively.	10	Model QP

	<table><tr><td>G</td><td>90 MVA</td><td>22 kV</td><td>X=18%</td></tr><tr><td>T_1</td><td>50 MVA</td><td>22/220 kV</td><td>X=10%</td></tr><tr><td>T_2</td><td>40 MVA</td><td>220/11 kV</td><td>X=6%</td></tr><tr><td>T_3</td><td>40 MVA</td><td>22/110 kV</td><td>X=6.4%</td></tr><tr><td>T_4</td><td>40 MVA</td><td>110/11 kV</td><td>X=8%</td></tr><tr><td>M</td><td>66.5 MVA</td><td>10.45 kV</td><td>X=18.5%</td></tr></table> 		
9	What are the advantages of pu system? Obtain the expression for converting the per unit impedance expressed on one base to another.	4	Model QP
10	Derive the expression for fault current and draw the interconnection of sequence networks for the line to line fault on the terminals of an unloaded generator.	10	KTU (SEP 2020)
11	Explain different types of current limiting reactors	5	KTU (DEC 2019)

Module 2			
1	Explain the algorithm for load flow analysis using Newton-Raphson Method.	10	KTU (DEC 2019)
2	The line admittance of a 4-bus system are as under <table><tr><td>Bus code</td><td>1-2</td><td>1-3</td><td>2-3</td><td>2-4</td><td>3-4</td></tr><tr><td>Admittance</td><td>2-j8</td><td>1-j4</td><td>0.666-j2.664</td><td>1-j4</td><td>2-j8</td></tr></table>The schedule of active and reactive powers is: <table><tr><td>Bus code</td><td>P</td><td>Q</td><td>V</td></tr><tr><td>1</td><td>--</td><td>--</td><td>1.06∠0</td></tr><tr><td>2</td><td>0.5</td><td>0.2</td><td>--</td></tr><tr><td>3</td><td>0.4</td><td>0.3</td><td>--</td></tr><tr><td>4</td><td>0.3</td><td>0.1</td><td>--</td></tr></table>	10	KTU (JULY 2021)

<table>
<tr><td></td><td>Form YBUS and compute the voltage at bus 2 at the end of first iteration using the G-S method. Take =1.6</td><td></td><td></td></tr>
<tr><td>3</td><td>Consider the three bus systems shown below. Each of the three lines has a series impedance of 0.02+j0.08 pu and a total shunt admittance of j0.02 pu. The specified quantities at the buses are tabulated below. A controllable reactive power source is available at bus 3 with the constraint 0≤ QG3≤ 1.5 PU. Find the load flow analysis using FDLF Method (one iteration)
<table>
<tr><th>Bus</th><th>Real load Demand, P_D</th><th>Reactive load demand, Q_D</th><th>Real power Generation, P_G</th><th>Reactive power Generation, Q_G</th><th>Voltage specification</th></tr>
<tr><td>1</td><td>2.0</td><td>1.0</td><td>Unspecified</td><td>Unspecified</td><td>$V_1 = 1.04 + j0$</td></tr>
<tr><td>2</td><td>0.0</td><td>0.0</td><td>0.5</td><td>1.0</td><td>Unspecified</td></tr>
<tr><td>3</td><td>1.5</td><td>0.6</td><td>0.0</td><td>$Q_{G3} = ?$</td><td>$|V_3| = 1.04$</td></tr>
</table></td><td>14</td><td>Model QP</td></tr>
<tr><td>4</td><td>For the system shown in the figure obtain the load flow solution at the end of 2 iterations by Gauss-Seidel method. The line impedances are marked in per unit on a 100 MVA base.

</td><td>10</td><td>Model QP</td></tr>
<tr><td>5</td><td>A power system consists of 300 buses out of which 20 buses are generator buses and 25buses are provided with reactive power support. All other buses are load buses. Determine the size of the Newton Raphson load flow Jacobian matrix.</td><td>3</td><td>Model QP</td></tr>
<tr><td>6</td><td>What is the need of slack bus in load flow analysis?</td><td>3</td><td>Model QP</td></tr>
<tr><td>7</td><td>Write down the steps involved in solving the load flow equation</td><td>7</td><td>KTU</td></tr>
</table>

<table>
<tr><td></td><td>using Guass Siedel method when voltage-controlled buses are absent.</td><td></td><td>(SEP 2020)</td></tr>
<tr><td>8</td><td>Derive the static load flow equations for a power system.</td><td>10</td><td>KTU (SEP 2020)</td></tr>
<tr><td>9</td><td>Explain DC load flow.</td><td>4</td><td>Model QP</td></tr>
<tr><td>10</td><td>Give reasons for:
i) Direct solution of load flow problem is not possible.
ii) Bus admittance matrix is sparse matrix</td><td>5</td><td>KTU (DEC 2019)</td></tr>
<tr><td>11</td><td>Figure shows a three-bus power system. The impedance of each line is (0.026 + 0.11) pu.
Assuming a flat voltage start, find the voltages and bus angles at the buses at the end of the first iteration using the Gauss-Siedel method.
 

The bus details are given in the table below
<table><tr><th>Bus</th><th>P_G(pu)</th><th>Q_G(pu)</th><th>P_L(pu)</th><th>Q_L(pu)</th><th>|Vi|(pu)</th><th>Angle</th><th>Remarks</th></tr><tr><td>1</td><td>-</td><td>-</td><td>1.0</td><td>0.5</td><td>1.03</td><td>0^0</td><td>Slack bus</td></tr><tr><td>2</td><td>1.5</td><td>-</td><td>0</td><td>0</td><td>1.03</td><td>-</td><td>PV bus</td></tr><tr><td>3</td><td>0</td><td>0</td><td>1.2</td><td>0.5</td><td>-</td><td>-</td><td>PQ bus</td></tr></table></td><td>5</td><td>KTU May 2019</td></tr>
</table>

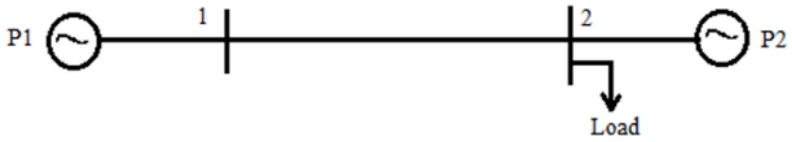
<table>
<tr><th colspan="4">Module 3</th></tr>
<tr><td>1</td><td>Starting from first principles derive the swing equation of a synchronous machine</td><td></td><td>Model QP</td></tr>
<tr><td>2</td><td>Using equal area criterion, derive an expression for critical clearing angle for a system having a generator feeding an infinite bus through a single circuit line.</td><td>10</td><td>KTU (DEC 2019)</td></tr>
<tr><td>3</td><td>Explain the method of solving swing equation by point-by-point method.</td><td>5</td><td>KTU (DEC 2019)</td></tr>
<tr><td>4</td><td>Explain PMU and Wide area network</td><td>6</td><td></td></tr>
<tr><td>5</td><td>Two generators rated at 4-pole, 50 Hz, 50 MW 0.85 p.f (lag) with a</td><td>8</td><td>Model</td></tr>
</table>

	moment of inertia28,000 kg-m2 and 2-pole, 50Hz, 75 MW 0.82 p.f (lag) with a moment of inertia 5,000 kg-m2 are connected by a transmission line. Find the inertia constant of each machine and the inertia constant of a single equivalent machine connected to an infinite bus. Take 100 MVA base.		QP
6	A 50 Hz generator is delivering 50% of the power that it is capable of delivering through a transmission line to an infinite bus. A fault occurs that increases the reactance between the generator and the infinite bus to 500% of the value before the fault. When the fault is isolated, the maximum power that can be delivered is 75% of the original maximum value. Determine the critical clearing angle for the condition described	10	Model QP
7	Explain the steady-state limit of a power system with the help of a power angle diagram.	3	KTU (SEP 2020)
8	What are the methods of improving transient stability?	4	KTU (JULY 2021)
9	Give the simplified power angle equation and the expression for Pmax .Also draw the power angle curve.	4	KTU (JULY 2021)
10	Explain the critical clearing angle and its significance with respect to the stability of a power system.	3	Model QP
11	Explain the three different stabilities of a power system.	5	KTU (SEP 2020)

Module 4			
1	A 50Hz,4 pole turbogenerator of rating 20 MVA,13.2 kV has an inertia constant of H=9kW-sec/ kVA. Find the kinetic energy stored in the rotor at synchronous speed.	5	KTU (JULY 2021)
2	What are the main components of a speed governor system?	5	KTU (JULY 2021)
3	Two turbo-alternators rated for 110 MW and 210 MW have	10	Model

	governor drop characteristics of 5 percent from no load to full load. They are connected in parallel to share a load of 250 MW. Determine the load shared by each machine assuming free governor action.		QP
4	Develop and explain the block diagram of automatic load frequency control of an isolated power system.	10	Model QP
5	A 100MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is suddenly reduced by 50 MW. Due to time lag in the governor system, the steam valve begins to close after 0.4 s. Determine the change in frequency that occurs in this time. Given H= 5kW-s/kVA.	5	KTU (DEC 2019)
6	With a neat block diagram explain the automatic voltage regulator of a generator.	5	KTU (JULY 2021
7	Discuss the application of SCADA in power system monitoring	3	Model QP
8	Derive the block diagram representation of a generator-load model	5	KTU (DEC 2019
9	A 100 MVA synchronous generator operates on full load at a frequency of 50 Hz. Inertia constant is 8 MJ/MVA. The load is suddenly reduced 100 MW. Due to timelag in the governor system, the steam valve begins to close after 0.4 seconds. Determine the change in frequency that occurs in this time.	4	Model QP
10	Draw the block diagram representation of Load Frequency Control (LFC) of a single area system & explain the steady-state stability for free governor operation	10	KTU (DEC 2019)
11	Enumerate the reasons for keeping strict limits on the system frequency variations.	4	Model QP

Module 5			
1	Explain unit commitment? List out the constraints on unit commitment.	3	Model QP

2	How loads are distributed between units within a plant?	5	KTU (DEC 2019)
3	A two-bus system is shown in figure below. If a load of 125MW is transmitted from plant 1 to the load, a loss of 15.625MW is incurred. Determine the generation schedule and the load demand if the cost of received power is Rs.24/MWhr. Solve the problem using coordination equations and the penalty factor method. The incremental production costs of the plants are: $dF_1/dP_1 = 0.025P_1 + 15$ $dF_2/dP_2 = 0.05P_2 + 20$ 	10	KTU (DEC 2019)
4	Write the conditions for the optimal power dispatch in a lossless system.	3	Model QP
5	Derive the equation for penalty factor for optimal system operation.	5	KTU (JULY 2021)
6	Draw fuel-cost curve and explain	4	KTU (JULY 2021)
7	The incremental fuel cost of two generating units G1 and G2 is given by IC1 = 25+0.2P1, IC2 = 32+0.2P2, where P1 and P2 are real powers generated by the unit. Find the economic allocation for a total load of 250 MW. Neglect the transmission losses.	4	Model QP
8	The fuel inputs per hour of plants 1 and 2 are given as F1 = 0.2 P1^2 + 40 P1 + 120 Rs. per hr F2 = 0.25 P2^2 + 30 P2 + 150Rs. per hr Determine the economic operating schedule and the corresponding	6	Model QP

	cost of generation if the maximum and minimum loading on each unit is 100 MW and 25 MW, the demand is 180 MW, and transmission losses are neglected. If the load is equally shared by both the units, determine the saving obtained by loading the units as per equal incremental production cost		
9	What is the significance of thermal unit constraint in the unit commitment problem?	5	KTU (DEC 2019)
10	A power plant has 3 units with the following cost curves: C1 =P1^2 + 430 P1 +10000 Rs/hour C2 =2 P2^2 + 540 P2 +10000 Rs/hour C3 = 1.4 P3^2 + 320 P3 +18000 Rs/hour Maximum and minimum generation for each unit is 120MW and 36MW. Find the optimum scheduling for a total load of 200 MW	7	KTU (JULY 2021)
11	A 2 bus system consists of two power plants connected by a transmission line. The cost curve characteristics of the two plants are C1= 0.01P1^2+ 16P1+20 Rs/hr C2= 0.02P2^2 +20P2 +40 Rs/hr When a power of 120 MW is transmitted from plant 1 to load (near to plant 2), a loss of 14 MW has occurred. Determine the optimal scheduling of plants and load demand, if the cost of received power is 30 Rs./MWhr.	10	Model QP

EET306 POWER ELECTRONICS

MODULE 1			
Sl.No	**Question**	**Marks**	**KU/KTU Month/Year**
1	"A thyristor can be triggered by an external gate pulse"- Justify using two transistor analogy of thyristor	5	KTU APRIL 2018
2	a) With neat sketches, explain the static V-I characteristics of an SCR. Define latching and holding current. b) Two thyristors having a difference of 4 mA in latching current are connected in series. The voltage across the devices are 500 V and 480 V. Calculate the derating factor and the static equalizing resistance value for maximum string efficiency.	6	KTU APRIL 2018, DEC 2019(a)
3	a) Compare the characteristic features of MOSFET and IGBT b) Give the structure and operation of TRIAC.	4	KTU DEC 2019
4	Draw the circuit for two transistor analogy of silicon controlled rectifier and briefly describe the working.	10	KTU OCT 2020
5	a) Derive the expression for resistance used for static voltage equalization for a series connected string. b) In a power circuit, 4 SCRs are to be connected in series in a string to handle 6kV and 1kA. The voltage and current ratings of SCRs are 1800V and 1000A and have a maximum difference in their blocking currents of 10mA. Difference in recovery charge is 10μC. Design a suitable equalizing circuit with fig	10	KTU DEC 2017
6	a) Explain the structure & principle of operation of IGBT. b) Draw RC triggering circuit for SCR and explain with relevant waveforms.		KTU DEC 2017
7	Define holding current and latching current of SCR.		KTU DEC 2017

8	a) Discuss the condition which must be satisfied for turning on the SCR with a gate signal. b) Explain how di/dt and dv/dt protection is accomplished in SCR		KTU DEC 2017

MODULE 2

Sl.No	Question	Marks	KU/KTU Month/Year
1	Explain how the firing angle of an SCR can be varied by using a UJT relaxation oscillator.	5	KTU APRIL 2018
2	Compare the maximum power that can be handled by fully controlled rectifier in mid- point and bridge configuration if the firing angle is 30o and the reverse voltage rating (peak) of the thyristors is 200V.	5	KTU APRIL 2018
3	a) Explain a half-wave controlled rectifier feeding RL load, with waveforms of (6) output voltage and output current. Derive the expression for average output voltage.	6	KTU APRIL 2018
	b) A single phase semi-converter fed from 120 V, 50 Hz supply is connected to a (4) load resistance of 10 Ω. If the average output voltage is 25% of its maximum possible average output voltage, find the circuit turn off time.	4	KTU DEC 2019
4	a) Describe a single phase half controlled converter with RL load along with necessary circuit diagram and waveforms.	4	KTU DEC 2019
	b) A neat circuit diagram explains the operation of a Single Phase Half Wave Rectifier with R, load. Sketch the shape of output voltage waveform	6	
5	Explain R firing circuit of SCR with circuit diagram and waveforms.	5	KTU OCT 2020

6	With the help of circuit diagrams explain the working of a single phase fully controlled converter with RL load. Draw the waveform of output voltage with and without freewheeling diode and output current.	10	KTU APRIL 2018
7	With the help of circuit diagrams explain the operation of a single phase semi converter with RL load. Draw the waveform of input voltage, output voltage, load current and voltage across the thyristor.	6	KTU APRIL 2018
8	A fully controlled full wave converter has a source of 240 V rms, 50 Hz and 10 Ω, 50mH, 50V Emf opposing series load. The delay angle is 45o. Determine a) Average output voltage and current. b) Rms load voltage and Rms voltage across the RL part of the load. c) The power absorbed by the 50V load back emf	6	KTU DEC 2019
9	a)Illustrate how a Thyristor based 1-phase fully controlled rectifier can be used to convert ac into variable dc. Draw the waveforms of output voltage & output current for both R and RL load at α=30	6	KTU OCT 2020
	b) Obtain an expression for average dc output voltage of a 1-phase fully controlled rectifier for R load with firing angle, α.	4	
10	What is the role of freewheeling diode in a 3 phase semi-converter?	5	KTU APRIL 2018
11	a) Sketch the circuit diagram and explain the working of a 3 phase full wave controlled rectifier with RLE load. Draw the output voltage waveforms corresponding to α = 60	10	KTU APRIL 2018 , DEC 201 ,KTU OCT 2020
	b) A three-phase half-wave controlled converter is connected to 380 V (line) supply. If the load current is constant at 32 A independent of the firing angle and on state forward drop of SCRs is 1.2 V, Find: i) Peak reverse voltage rating of SCRs ii) Average power dissipation in each SCR	4	
12	Draw the input and output voltage waveforms of 3ø half controlled rectifier with R load for a firing angle of 30	5	KTU DEC 2017

13	A three phase half wave converter is operated from 3– phase, 230 V, 50Hz supply with load resistance R= 10Ω. An average output voltage of 50% of the maximum possible output voltage is required. Determine i) the firing angle, ii) average and rms values of load current	5	KTU DEC 2018
14	a) With the help of circuit diagram explain the working of a three phase fully controlled converter.	5	KTU DEC 2018
	b) Sketch the waveform of input voltage, output voltage and output current of a three phase fully controlled converter with R load operating at α = 30	5	
15	Draw the output voltage waveform of a 3-phase controlled half wave rectifier for α=30	5	5 KTU OCT 2020

MODULE 3

Sl.No	Question	Marks	KU/KTU Month/Year
1	Compare voltage source and current source inverters.	5	KTU APRIL 2018
2	A single-phase half bridge inverter has a resistive load of 10 Ω, and a center-tap dc input voltage of 96 V. Obtain the Fourier series representation of the output voltage waveform and hence find the value of distortion factor.	4	KTU APRIL 2018
3	Explain the 120 degree conduction mode of a three-phase bridge inverter with output voltage waveforms,	10	KTU APRIL 2018
4	What are the different classifications of inverters?	5	KTU DEC 2017

5	Explain the operation of 3 phase voltage source inverter with 180 degree mode of operation.	10	KTU DEC 2017
6	With the help of circuit diagrams explain the working of the current source inverter.	5	KTU APRIL 2018
7	a) Describe the working of a three phase voltage source inverter with an appropriate circuit diagram.	4	KTU APRIL 2018
	b) Draw the phase and line voltage waveform of the three phase voltage source inverter with star connected resistive load on the assumption that each IGBT conducts for 180	6	
8	Explain the working of a single phase half bridge voltage source inverter with pure R load. Draw the output voltage & output current waveforms and derive an expression for rms output voltage.	5	KTU OCT 2020
9	Draw the circuit and explain the 180 degree operation of a 3 phase bridge inverter with R load. Draw the phase voltage and line voltage waveforms.	10	KTU DEC 2019, OCT 2020
10	A 50Hz single phase full bridge square wave inverter is fed from 500V dc input. Find output rms voltage and current for a load of R=5Ω and L=10mH.	10	KTU OCT 2020
11	What is sequence control in single phase ac voltage controllers? What are the advantages of employing it?	10	KTU APRIL 2018
12	a) Explain the operation of a single phase voltage controller with RL load with output voltage and current waveforms.	6	KTU APRIL 2018
	b) For a single-phase voltage controller, develop a relationship between conduction angle and firing angle. Under what condition does the conduction angle equals π?	4	

13	For a single phase voltage controller feeding a resistive load, describe the working with reference to source voltage, source current, output voltage and output current.	10	KTU APRIL 2017
14	Explain with relevant waveforms a Single phase AC voltage controller with RL load	10	KTU APRIL 2019
15	For a single phase ACVC with source voltage as , and load as , draw the output voltage and current waveforms if Thyristor firing angle is (i) α=300 (ii) α=900.	10	KTU OCT 2019

MODULE 4

Sl.No	Question	Marks	KU/KTU Month/Year
1	A step up chopper has input voltage of 120V and output voltage of 360 V. If the conducting time of the thyristor chopper is 100 μs, Compute the pulse width of output voltage	10	KTU APRIL 2018
2	For a type A chopper, dc source voltage is 230 V, load resistance 10 Ω, drop across the switch is 2 V and duty cycle 0.4. Calculate average and RMS value of output voltage and chopper efficiency.	5	KTU APRIL 2018
3	Draw the circuit of the step up chopper and explain its working.	5	KTU APRIL 2018
4	Explain with circuit diagram and waveforms, the working of Buck regulator for continuous current mode. Obtain expressions for inductance and capacitance.	10	KTU DEC 2017
5	How four-quadrant operation is achieved in a Type E Chopper? Explain with a neat circuit diagram.	10	KTU DEC 2017
6	Derive an expression for average output voltage in terms of input dc voltage and duty cycle for a step up chopper.	5	KTU DEC 2017
7	Explain the different methods by which control of output voltage is obtained in Choppers.	5	KTU DEC 2019

8	With circuit diagrams and waveforms, describe the operation of a buck-boost dc dc converter. Derive expressions for output dc voltage and the design equations for filter inductor & capacitor	10	KTU OCT 2020
9	Draw the waveform of inductor voltage of a boost dc- dc converter and obtain an expression for output dc voltage in terms of input voltage and duty cycle.	5	KTU OCT 2020
10	For a dc-dc buck-boost converter with a dc input voltage of 50V and output voltage of 100V, calculate(i) duty cycle (ii) value of inductor if inductor ripple current ΔI =10mA. Given the switching frequency is 10kHz	5	KTU OCT 2020
11	In a step down chopper the dc input voltage is 100V. The MOSFET switch has a switching frequency of 2kHz. Find the duty cycle and average dc output voltage if the turn on period of switch is 0.2ms	5	KTU OCT 2020

MODULE 5

Sl.No	Question	Marks	KU/KTU Month/Year
1	Draw the block diagram of a closed loop speed control of an electric drive. Differentiate between passive and active load torques.	8	KTU April 18
2	A motor when operating in quadrant I and II has the characteristic T = 400 – 0.4N Nm, where N is the speed in rpm. The load which is coupled to the motor is an active load with the characteristic, T l = ±200 Nm. Calculate the motor speeds for motoring and braking operation in the forward direction. When the drive is operating in quadrant III and IV, motor has the characteristic T =- 400 - 0.4N Nm. What will be the equilibrium speed in quadrant	7	KTU April 18
3	Draw and explain the speed torque curves of a fan load and traction load	4	KTU April 18
4	Derive an expression for equivalent moment of inertia and equivalent torque for a motor load system for loads with rotational motion, all referred to the motor shaft.	5	KTU April 18
5	What are the different components of a load torque? Explain each	5	KU

	component in detail.		April 16
6	What are the different components of a load torque? Explain each component in detail.	5	KTU April 19
7	Derive the mathematical condition to obtain the steady state stability of equilibrium point.	5	KTU April 19
8	What is an Electric Drive? Explain the function of each blocks with the help of a neat block diagram.	5	KTU April 19
9	A5MW, 3phase, 11 kV, Connected, 6pole, 50Hz, 0,9 leading power factor synchronous motor has Xs = 9 fi andRs = 0 . Rated field current is 50 A. Machine is controlled by variable frequency control at constantV/f ratio up to the base speed and at constant voltage, above rated speed.	5	KTU April 18
10	Determine (i)Torque and field current for the rated armature current, 750 rpmand0.8leadingpowerfactorand (ii)Armature current and power factor for half the rated motor torque, 1500 rpmand ratedfield current	5	
11	Draw and explain the torque speed characteristics of 3 phase induction motors under v/f control.	10	KU May 13
12	Draw and explain the torque speed characteristics of 3 phase induction motor under v/f control.	10	KU May 13
13	Draw and explain the forward motoring and regenerative braking operation of a chopper fed DC motor	10	KU May 13
14	Explain the simultaneous and non simultaneous control of dual convertor	10	KU Oct 14

EET312 - BIOMEDICAL INSTRUMENTATION

Module 1			
Sl No.	**Questions**	**Marks**	**KU/ KTU (Month/ Year)**
1	(a) Write short notes on 1) resting potential 2) action potential? (b) Explain the developments of action potential with respect to human cells with necessary figures. (c) Write a short note on Resting potential, Action potential and Propagation of Action potential with Action potential waveform.	5	KTUDec2017
2	Identify the various types of transducers used in Biomedical engineering? Write principle of operation of any 5 transducers.	10	KTU April 2018
3	(a) Briefly explain the physiological functions of humanrespiratory system. (b) Explain the measurement of respiratory parameters using spirometer. Write brief notes on respiratory parameters.	5	KTU Decembe r 2019
4	(a) Draw the block diagram of biomedical instrumentation system and explain the functions of each block. (b) Identify the various problems encountered in biomedical measurements? (c) With the help of a neat block diagram write how a man instrumentsystem working.	5	KTUDec201 7, KTUDec202 0
5	(a)Discuss what are the problems encountered in measurement on biological systems. (b)What are bio signals? Give specific examples.	5	KTU May 2019
6	(a) Discuss about surface electrodes. Explain electro conduction pathway of heart. (b) Explain the construction and working principle of microelectrodes. (c) Explain the effect of electrode potential on bio signals. (d) Briefly explain different Bio potential electrodes (e) Explain the construction and working principle of microelectrodes (f) Enumerate various skin surface electrodes. Write principle of operation of any THREE electrodes. (g) Mention the applications of floating and flexible type surface electrodes with necessary figures	10	KTU Sep2020 KTUDec2018 KTU May2019
7	Discuss the functional organisation of peripheral nervous system.	5	KTUDec2018
8	With the help of necessary figure explain the working of cardiovascular system of human body.	6	KTU May 2019
9	What is cardiac vector? Explain ECG leads with necessary figures.	4	KTUDec2019

Module 2

Sl No.	Questions	Marks	KU/ KTU (Month/ Year)
1	(a) With the help of a neat diagram of the Einthoven triangle, mention the necessity of the Einthoven triangle. (b) Explain Einthoven triangle.	5	KTUDec2019
2	(a) With the help of neat diagram explain ultrasonic method of blood pressure measurement. (b) What is blood pressure? How it is measured? (c) With help of neat diagram write how the oscillometric method helps to measure blood pressure. (d) Explain the direct method of blood pressure measurement. (e) Explain auditory method of blood pressure measurements with necessary figure (f) Explain the method of blood flow measurement using electromagnetic blood flowmeter	6	KTUDec2019
3	What is cardiac vector? Explain ECG leads with necessary figures.	6	KTUDec2019
4	Explain about pneumograph with relevant diagrams.	5	KTUDec2018
5	(a) Explain any one method to measure blood flow (b) Explain the method of blood flow measurement using electromagnetic blood flow meter.	6	KTUDec2018
6	With help of neat diagram explain phonocardiography.	10	KTUApril2018
7	How we can measure Blood pressure using Fibre optic system.	5	KTUDec2017
8	(a) Explain the measurement of respiratory parameters using spirometer. (b) With neat diagram write the principle of working of a spirometer.	10	KTUDec2017
9	(a) Identify difference between Internal and External pacemakers. (b) Discuss electrical conduction path way of heart and explain the working principle of artificial cardiac pacemaker with necessary figures	10	KTUDec2017
10	Explain standered 10-20 electrode placement system for EEG measurement	10	KTUApril2018
11	(a) Explain spirometer for measurement of respiratory parameters (b) Explain the measurement of respiratory parameters using Spirometer	5	KTUDec2018
12	Write short note on Photo plethysmograph	6	KTUDec2018
13	Write short note on Respiratory pneumograph	5	KTUDec2019
14	Explain the measurement of Cardiac output.	6	KTUDec2019
15	(a) Explain the Ultrasonic method of blood pressure measurement. (b) Explain the direct method of blood pressure measurement.	7	KTU Sep2020

Module 3			
Sl No.	**Questions**	**Marks**	**KU/ KTU (Month/ Year)**
1	(a) Explain the 10-20 system of EEG electrodes placement. (b) Draw and explain the block diagram of EEG machine. (c) Draw the different EEG waveforms and state its frequency. (d) What are the applications of EEG waveforms? (e) Explain standered 10-20 electrode placement system for EEG measurement. (f) What are brain waves? Write notes on measurement of EEG with necessary block diagram.	10	KTUDec2017
2	Explain ECG with a neat block diagram	4	KTUDec2018, 2019
3	Explain the significance of Einthoven triangle.	4	KTUDec2019
3	Write brief note on measurement of nerve conduction velocity.	5	KTU Sep2020
4	Explain DC defibrillator with the help of neat diagram	6	KTU Sep2020
5	Explain spirometer for measurement of respiratory parameters	10	KTU Dec2017
6	Describe the working of electronic pacemaker with necessary diagram.	5	KTUApril2018
7	Write a short note on tidal volume and vital capacity in breathing mechanism with neat diagram.	5	KTUMay2019
8	With neat diagram write how we can measure velocity of conduction in nerve.	5	KTUDec2020
9	Write a short note on phonocardiography.	5	KTUDec2020
10	With neat diagram write the principle of working of a spirometer.	10	KTUDec2020
11	With neat diagram EMG recorders	10	KTUApril2018
12	Write brief note on Electromyography	6	KTU 2018, 2019
13	Write brief note on Pneumography	5	KTU December 2019
14	Explain briefly measurements from the nervous system.	10	KTUMay, Dec2019

Module 4

Sl No.	Questions	Marks	KU/KTU (Month/ Year)
1	What are the different methods of accident prevention in hospitals?	10	KTUDec 2018
2	Differentiate between macro shock and micro shock.	10	KTUDec 2018
3	Explain the physiological effects of electric current.	6	KTUDec 2018
4	(a) Explain the generation of X-rays and also mentionits applications in biomedical engineering. (b) Explain the properties and biomedical applications of X-rays. (c) Enumerate uses of X-rays-diagnostic still picture. (d) Explain the biomedical applications of X-Ray withsupporting diagrams. (e) With neat diagram explain the working of X-raymachine. Enumerate the uses of X-rays in medicine?	10	KTUDec 2019
5	Explain the principle of CAT scanning	5	KTUApril 2018
6	(a) Explain the principle of MRI scanning (b) Explain MRI and PET scanning.	10	KTUApri l 2018
7	With neat diagram explain the working of Aritifical kidney.	5	KTUDec2019
8	Discuss the principle and application of diathermy.	10	KTUDec 2017
9	Mention different types of ventilators and write brief notes on the biomedical applications	5	KTUDec2017
10	List the main types of blood test and explain each	5	KTUApril20 1 8,Dec 2017,2019
11	With the help of a block diagram explain the basic principle of Computer tomograph	10	KTUDec 2019
12	Enumerate commonly used chemical tests on blood cells.	5	KTU Sep2020
13	Discuss the principle of Lithotripsy.	10	KTU Sep2020
14	Write brief notes on ultrasound scanning.	5	KTU Sep2020

15	Explain De-fibrillators.	5	KTUDec 2017

Module 5

Sl No.	Questions	Marks	KU/KTU (Month/ Year)
1	Write how a Flame photometer helps in blood test.	5	KTUDec2017
2	Identify how lithotripsy helps us. Write how it works.	5	KTUApril, Dec2018,2017
3	List out various physiological effects of electric current.	10	KTUApr2018
4	List various components in infant incubators? Mention function of components.	10	KTUDec2019
5	Identify the situation to use diathermy? Mention its applications?	10	KTU Sep2020
6	Write a short note haematocrit.	5	KTU Sep2020
7	(a) Write a short note on Tele-medicine. (b) Discuss telemedicine. What are its biomedical applications	5	KTU Sep2020
8	(a) What is infant incubator? Explain with necessary diagram. (b) Draw the block diagram of infant incubator and explain (c) Write short note on infant incubator	4	KTU April 2018
9	Explain the physiological effects of electric current, specifying important susceptibility parameters with necessary figures.	5	KTU April 2018, May 2019
10	(a) What is haemodialysis? Explain the working of an artificial kidneywith necessary diagram. (b) Explain artificial kidney with neat sketches	10	KTUMay2019
11	Write short notes on blood cell counter.	5	KTUJan2022
12	What is micro shock? How it is affected to human body?	10	KTUJan2022
13	Explain physiological effects of electric currents and write brief notes on various susceptibility parameters.	5	KTUJan2022

14	With the help of a block diagram explain the basic principle of Computer tomograph.	5	KTUDec2020
15	Explain different methods of electric accident prevention.	10	KTUDec2020
16	Explain in detail different clinical tests conducted on blood.	10	KTUSept2020
17	Discuss the principle and application of diathermy.	5	KTUJan2022
18	Write a note on medical robotics	5	KTUJan2022