SEMESTER -3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
EET201	**CIRCUITS AND NETWORKS**	**PCC**	**2**	**2**	**0**	**4**

Preamble : This course introduces circuit analysis techniques applied to dc and ac electric circuits. Analyses of electric circuits in steady state and dynamic conditions are discussed. Network analysis is introduced with network parameters and transfer functions. This course serves as the most important prerequisite of all many advanced courses in electrical engineering.

Prerequisite : **Basics of Electrical Engineering / Introduction to Electrical Engineering**

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Apply circuit theorems to simplify and solve complex DC and AC electric networks.
CO 2	Analyse dynamic DC and AC circuits and develop the complete response to excitations.
CO 3	Solve dynamic circuits by applying transformation to s-domain.
CO 4	Analyse three-phase networks in Y and Δ configurations.
CO 5	Solve series /parallel resonant circuits.
CO 6	Develop the representation of two-port networks using network parameters and analyse.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3										2
CO 2	3	3										2
CO 3	3	3										2
CO 4	3	3										2
CO 5	3	3										2
CO 6	3	3										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State and explain network theorems (K1)
2. Problems on solving circuits using network theorems. (K2, K3)

Course Outcome 2 (CO2):

1. Distinguish between the natural response and forced response. (K2, K3)
2. Problems on steady state and transient analysis of RL, RC and RLC series circuits with DC excitation and initial conditions. (K2, K3)
3. Problems on steady state and transient analysis of RL, RC and RLC series circuits with sinusoidal excitation. (K2, K3)

Course Outcome 3 (CO3):

1. Problems on mesh analysis and node analysis of transformed circuits in s-domain (K2, K3).
2. Problems on solution of transformed circuits including mutually coupled circuits in s-domain (K2, K3).

Course Outcome 4 (CO4):

1. Problems on analysis of unbalanced Y and Δ configurations. (K2, K3)
2. Evaluation of neutral shift voltage in unbalanced systems. (K2, K3).

Course Outcome 5 (CO5):

1. Define Bandwidth, and draw the frequency dependence of impedance of an RLC network. (K1).
2. Develop the impedance/admittance Vs frequency plot for the given RLC network. (K2).
3. Evalutate the parameters such as quality factor, bandwidth,

Course Outcome 6 (CO6):

1. Problems on finding Z, Y, h and T parameters of simple two port networks. (K2).
2. Derive the expression for Z parameters in terms of T parameters. (K1).
3. Show that the overall transmission parameter matrix for cascaded 2 port network is simply the matrix product of transmission parameters for each individual 2 port network in cascade. (K1).

Model Question paper

QP CODE:

PAGES:4

Reg. No:______________
Name:______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EET 201

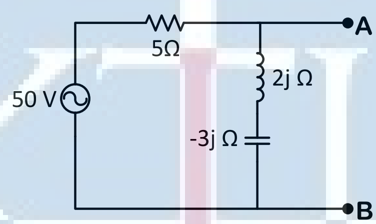
Course Name: CIRCUITS AND NETWORKS

Max. Marks: 100 Duration: 3 Hours

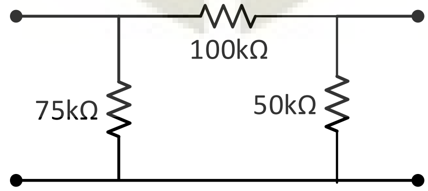
PART A (3 x 10 = 30 Marks)

Answer all Questions. Each question carries 3 Marks

1. State and explain superposition theorem using an example.
2. Obtain Thevenin's equivalent for the following circuit w.r.t terminals A and B:



3. Define time constant of a circuit. What is the time constant of an RL circuit?
4. How are RLC networks classified according to damping ratios? Sketch the various responses when an RLC series circuit is excited by a DC source.
5. Explain the dot convention used in coupled circuits.
6. Derive the s-domain equivalent circuit of an inductor carrying an initial current of Io.
7. Describe the variation of impedance and phase angle as a function of frequency in a series RLC circuit.
8. Define quality factor. Derive quality factor for inductive and capacitive circuits.
9. Derive the condition for symmetry & reciprocity in terms of T parameters.
10. Obtain Y parameters of the following network:

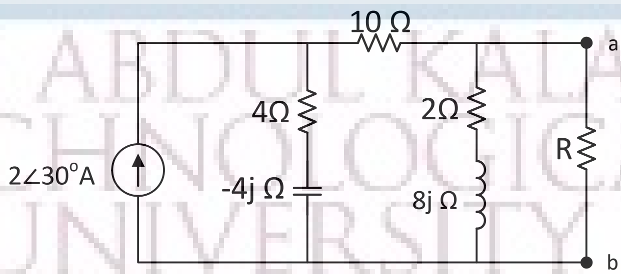


PART B (14 x 5 = 70 Marks)

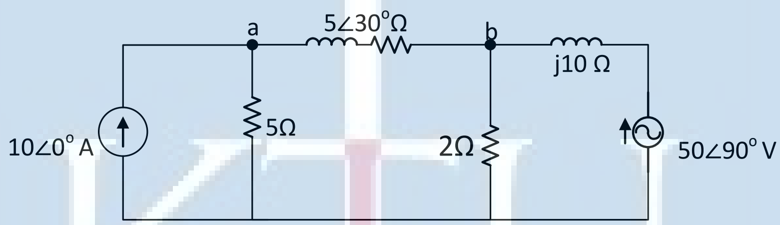
Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. With respect to the following circuit,
    a) Find the value of Resistor 'R' that results in maximum power transfer to it. **(10)**
    b) Find the value of maximum power transferred to 'R'. **(4)**

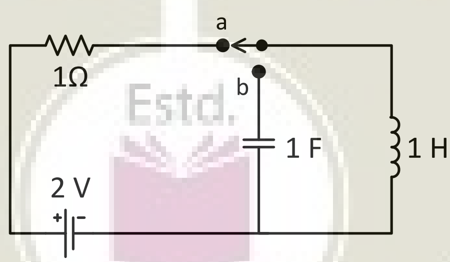


12. With respect to the following circuit,
    a) Find the voltages at 'a' and 'b' using superposition theorem. **(10)**
    b) Obtain the active power dissipated in $5\angle30^{o}\Omega$ impedance. **(4)**

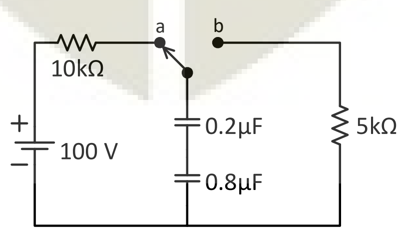


Module 2

13. a) In the following circuit, steady state exits when switch is in position 'a'. At time t = 0, the switch is moved to position 'b' .Obtain an expression for inductor current for time t > 0 **(6)**

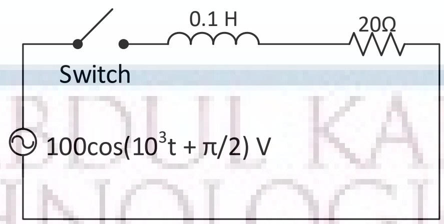


b) For the following circuit, switch 'S' is in position 'a' for a very long time. At time t = 0, the switch is thrown to position 'b'. Find the expression for current through 5kΩ. **(8)**



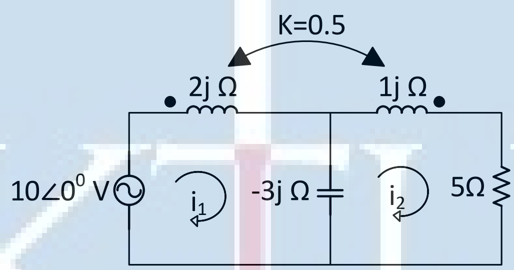
14. a) Given an RC circuit with zero initial charge on capacitor. Find the expression forcurrent after a DCsource 'V_{DC}' is applied to the RC network. Also determine thetime constantofthe circuit. **(4)**

b) Obtain an expression for current in the following circuit after switch is closed attime t=0. Use Laplace transform method. **(10)**

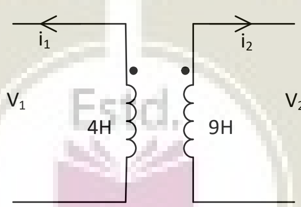


Module 3

15. a) For the following coupled circuit, the coupling coefficient, K =0.5. Write the KVL equations for currents i_1 and i_2. Also obtain the voltage drop across 5Ω resistor. **(10)**



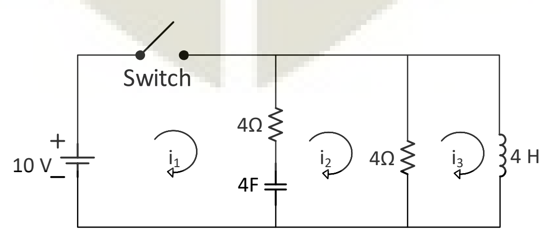
b) In figure, L_1=4H, L_2=9H, coefficient of coupling K=0.5,i_1 = 5 cos(50t-300) Amps, i_2 = 2cos(50t-300) Amps. Write the KVL equations for V_1 and V_2. Find their values at t=0 **(4)**



16. In the circuit shown, at time t = 0, the switch was closed.

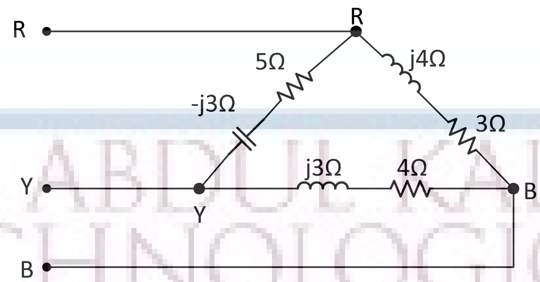
a. Model the circuit in s-domain for time t > 0. **(4)**

b. Through mesh analysis, obtain the time domain values of values of i_1, i_2 and i_3 Given that the capacitor and inductor were initially relaxed. **(10)**



Module 4

17. The following load is delta connected to a 100V three phase system. Find the phase currents, line currents and total power consumed by the load. **(14)**



18. An unbalanced 4 wire, star connected load is connected to a balanced voltage of 400V.
The loads are: $Z_1 = (3 + 6j)\Omega; Z_2 = (2 + 2j)\Omega; Z_3 = (14 + 18j)\Omega$
Calculatea) Line currents **(4)**

b) Current in neutral wire **(4)**

c) Total power **(6)**

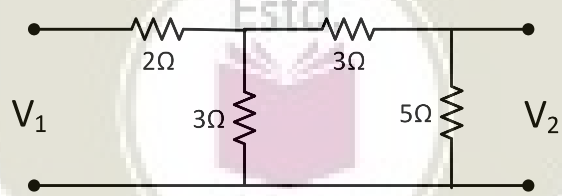
Module 5

19. a) Discuss series and parallel interconnection of 2-port networks. **(7)**

b) Derive the inter-relationship between Z and Y parameters. **(7)**

20. a) A network is given as $I_1 = 2.5V_1 - V_2; I_2 = -V_1 + 5V_2$
Draw its equivalent π network. **(4)**

b) Obtain h parameters of the following network: **(10)**



Syllabus

Module 1

Circuit theorems: DC and Sinusoidal steady state analysis of circuits with dependent and independent sources applying Superposition principle, Source transformation, Thevenin's, Norton's and Maximum Power Transfer theorems - Reciprocity theorem.

Module 2

Analysis of first and second order dynamic circuits: Formulation of dynamic equations of RL, RC and RLC series and parallel networks with dc excitation and initial conditions and complete solution using Laplace Transforms - Time constant - Complete solution of RL, RC and RLC circuits with sinusoidal excitation using Laplace Transforms – Damping ratio – Over damped, under damped, critically damped and undamped RLC networks.

Module 3

Transformed circuits in s-domain: Transform impedance/admittance of R, L and C - Mesh analysis and node analysis of transformed circuits in s-domain. Transfer Function representation – Poles and zeros.

Analysis of Coupled Circuits: – Dot polarity convention – Sinusoidal steady state analysis of coupled circuits - Linear Transformer as a coupled circuit - Analysis of coupled circuits in s-domain.

Module 4

Three phase networks and resonance: Complex Power in sinusoidal steady state. Steady state analysis of three-phase three-wire and four-wire unbalanced Y circuits, Unbalanced Delta circuit, Neutral shift.

Resonance in Series and Parallel RLC circuits – Quality factor – Bandwidth – Impedance Vs Frequency, Admittance Vs Frequency, Phase angle Vs frequency for series resonant circuit.

Module 5

Two port networks: Driving point and transfer functions – Z, Y, h and T parameters **-** Conditions for symmetry & reciprocity – relationship between parameter sets – interconnections of two port networks (series, parallel and cascade) — T-π transformation.

Text Books

1. Joseph A. Edminister and MahmoodNahvi, "Theory and Problems in Electric circuits", McGraw Hill, 5th Edition, 2010.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013

References:

1. Hayt and Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, New Delhi, 8th Ed, 2013.
2. Van Valkenberg, "Network Analysis", Prentice Hall India Learning Pvt. Ltd., 3 edition, 1980.
3. K. S. Suresh Kumar, "Electric Circuit Analysis", Pearson Publications, 2013.
4. Chakrabarti, "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018
5. R. Gupta, "Network Analysis and Synthesis", S. Chand & Company Ltd, 2010.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Network theorems - DC and AC steady state analysis (12 hours)**	
1.1	Linearity and Superposition principle - Application to the analysis of DC and AC (sinusoidal excitation) circuits. Application of source transformation in electric circuit analysis.	2
1.2	Thevenin's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	3
1.3	Norton's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	3
1.4	Maximum power transfer theorem - DC and AC steady state analysis with dependent and independent sources.	2
1.5	Reciprocity Theorem - Application to the analysis of DC and AC Circuits.	2
2	**First order and second order dynamic circuits. (9 hours)**	
2.1	Review of Laplace Transforms – Formulae of Laplace Transforms of common functions/signals, Initial value theorem and final value theorem, Inverse Laplace Transforms – partial fraction method. *(Questions to evaluate the Laplace/inverse transforms of any function / partial fractions method shall not be given in tests/final examination. Problems with application to circuits can be given).*	2
2.2	Formulation of dynamic equations of RL series and parallel networks and solution using Laplace Transforms – with DC excitation and initial	1

	conditions. Natural response and forced response. Time constant.	
2.3	Formulation of dynamic equations of RC series networks and solution using Laplace Transforms – with DC excitation and initial conditions. Natural response and forced response. Time constant.	1
2.4	Formulation of dynamic equations of RLC series networks with DC excitation and initial conditions, and solution using Laplace Transforms – Natural response and forced response. Damping coefficient. Underdamped, Overdamped, critically damped and undamped cases.	1
2.5	Formulation of dynamic equations of RL, RC and RLC series networks and solution with sinusoidal excitation. Complete solution (Solution using Laplace transforms).	2
2.6	Formulation of dynamic equations of RL, RC and RLC parallel networks and solution using Laplace Transforms – with DC and Sinusoidal excitations. Damping ratio.	2
3	**Transformed Circuits in s-domain and Coupled circuits (9 Hours)**	
3.1	Transformed circuits in s-domain: Transformation of elements (R, L, and C) with and without initial conditions.	2
3.2	Mesh analysis of transformed circuits in s-domain.	1
3.3	Node analysis of transformed circuits in s-domain.	1
3.4	Transfer Function representation – Poles and zeros.	1
3.5	Analysis of coupled circuits: mutual inductance – Coupling Coefficient-Dot polarity convention — Conductively coupled equivalent circuits. Linear Transformer as a coupled circuit.	2
3.6	Analysis of coupled circuits in s-domain.	2
4	**Three phase networks and resonance. (6 Hours)**	
4.1	Review of power, power factor, reactive and active power in sinusoidally excited circuits. Concept of complex power.	1
4.2	Steady state analysis of three-phase unbalanced 3-wire and 4-wire Y circuits, Unbalanced Δ circuits, Neutral shift.	2
4.3	Resonance in Series and Parallel RLC circuits – Quality factor – Bandwidth – Impedance Vs Frequency, Admittance Vs Frequency and Phase angleVs frequency for series resonant circuit.	3

5	**Two port networks (9 Hours)**	
5.1	Two port networks: Terminals and Ports, Driving point and transfer functions. Voltage transfer ratio, Current transfer ratio, transfer impedance, transfer admittance, poles and zeros.	2
5.2	Z –parameters. Equivalent circuit representation.	1
5.3	Y parameters. Equivalent circuit representation.	1
5.4	h parameters. Equivalent circuit representation.	1
5.5	T parameters.	1
5.6	Conditions for symmetry & reciprocity, relationship between network parameter sets.	1
5.7	Interconnections of two port networks (series, parallel and cascade).	1
5.8	T-π Transformation.	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EET203	**MEASUREMENTS AND INSTRUMENTATION**	PCC	**3**	**1**	**0**	**4**

Preamble : This course introduces principle of operation and construction of basic instruments for measurement of electrical quantities. Measurement of basic circuit parameters, magnetic quantities, and passive parameters by using bridge circuits, sensors and transducers will be discussed.Familiarization of modern digital measurement systems are also included.

Prerequisite :**Nil**

Course Outcomes :After the completion of the course the student will be able to

CO 1	Identify and analysethe factors affecting performance of measuring system
CO 2	Choose appropriate instruments for the measurement of voltage, current in ac and dc measurements
CO 3	Explain the operating principle of power and energy measurement
CO 4	Outline the principles of operation of Magnetic measurement systems
CO 5	Describe the operating principle of DC and AC bridges, transducersbased systems.
CO 6	Understand the operating principles of basic building blocks of digital systems, recording and display units

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	1	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	2

Assessment Pattern

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	03 Hrs

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	20	30
Understand	20	20	50
Apply	15	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1)

1. Explain static characteristics of measuring systems.
2. Problems related to measurement errors.
3. Concept of calibration of measuring instruments

Course Outcome 2 (CO2):

1. Explain the construction and working indicating Instruments.
2. Problems related to extension of range of meters

Course Outcome 3(CO3):

1. Describe the principle of operation and construction of energy meter
2. Describe the principle of operation and construction of wattmeter
3. Problems related to two and three wattmeter method of power measurement.

Course Outcome 4 (CO4):

1. Explain the principle of operation of ballistic galvanometer.
2. Describe the procedure for plotting the B-H curve of a magnetic specimen.

Course Outcome 5 (CO5):

1. Explain classification of Transducers
2. Measurement of frequency using Wien bridge.
3. Explain the operation of basic ac/dc bridges
4. Illustrate the principle of temperature measurement using thermocouple.

Course Outcome 6 (CO6):

1. Block diagram of DMM, CRO, DSO, PMU
2. Basic ideas on simulation softwares and virtual instrumentation.
3. Explain the operation of basic ac/dc bridges

Model Question paper
QPCODE: PAGES:3

Reg.No:____________

Name :_____________

APJABDULKALAMTECHNOLOGICALUNIVERSITY THIRD SEMESTERB.TECHDEGREEEXAMINATION,

MONTH &YEAR

Course Code: EET 203

Course Name: Measurements and Instrumentation

Max.Marks:100 **Duration: 3Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What are the different standards of measurement?
2. State and briefly explain the classification of electrical measuring instruments.
3. What are the special features incorporated in low power factor wattmeter?
4. Write short note on three phase energy meter.
5. Describe the working of hall effect sensors.
6. With the help of a diagram indicate the calibration of wattmeter using DC potentiometer.
7. Describe the method of determination of BH curve of a magnetic material.
8. What are the main requirements in magnetic measurements?
9. Explain briefly about digital voltmeter.
10. What is lissajouspattern. Indicate the factors on which shape of these figures depends.

(10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

1. (a) Explain the essentials of indicating instruments and what are the different methods of producing controlling torque in an analog instrument? **(6)**

(b) Explain with the help of neat sketches, the construction and working of attraction type moving iron instruments. Give the equation for torque of the MI instrument and the merits and demerits. **(8)**

2. (a) Discuss different types of damping. What is the necessity of damping and how damping is provided in PMMC instrument? **(8)**

   (b) A moving coil ammeter has fixed shunt of 0.01Ω. With a coil resistance of 750Ω and a voltage drop of 500mV across it, the full scale deflection is obtained. (1) Calculate current through shunt (2) Calculate resistance of meter to give full scale deflection if shunted current is 60A. **(6)**

Module 2

3. (a) Derive the expression for transformation ratio and phase angle of a current transformer using its equivalent circuit and phasor diagram. **(14)**

4. (a) Explain the construction and operation of dynamometer type wattmeter. **(7)**

   (b) With a neat block diagram, explain the working of electronic energy meter. What are its merits compared to induction type energy meter. **(7)**

Module 3

5. (a) Draw the circuit and phasor diagram of schering bridge for the measurement of capacitance, Derive the expression for the unknown capacitance.**(10)**

   (b) Explain loss of charge method for the measurement of high resistance. **(4)**

6. (a) Explain with the help of neat connection diagram how you would determine the value of low resistance by kelvin's double bridge method. Derive the formula used. **(7)**

   (b) Describe the method of measurement of earth resistance and what are the factors which affect the value of earth resistance? **(7)**

Module 4

7. (a)Explain the method of measurement of permeability. **(5)**

   (b) What is the principle of temperature measurement using thermistors and compare temperature measurement using RTD and thermistor. **(9)**

8. (a) Explain the working of flux meter. **(4)**

   (b) What is a Llyod- Fisher square. Explain the measurement of iron losses in a magnetic material employing Llyod- Fisher square using wattmeter method. **(10)**

Module 5

9. (a) With the help of a neat sketch explain the working of LVDT. Also draw its characteristics. **(6)**

   (b) Explain how CRO can be used to measure the frequency and phase angle. **(8)**

10. (a) How strain is measured using strain gauge. **(4)**

    (b) With a neat diagram, explain the working of a digital storage oscilloscope. **(10)**

(14x5=70)

Syllabus

Module 1

Measurement standards–Errors-Types of Errors- Statistics of errors, Need for calibration.

Classification of instruments, secondary instruments–indicating, integrating and recording-operating forces - essentials of indicating instruments - deflecting, damping, controlling torques.

Ammeters and voltmeters - moving coil, moving iron, constructional details and operation, principles shunts and multipliers – extension of range.

Module 2

Measurement of power: Dynamometer type wattmeter –Construction and working - 3-phase power measurement-Low Powerfactor wattmeters.

Measurement of energy: Induction type watt-hour meters- Single phase energy meter – construction and working, two element three phase energy meters,

Digital Energymeters -Time of Day(TOD) and Smart metering (description only).

Current transformers and potential transformers – principle of working -ratio and phase angle errors.

Extension of range using instrument transformers, Hall effect multipliers.

Module 3

Classification, measurement of low, medium and high resistance- Ammeter voltmeter method(for low and medium resistance measurements)-Kelvin's double bridge-Wheatstones bridge- loss of charge method, measurement of earth resistance.

Measurement of self inductance-Maxwell's Inductance bridge, Measurement of capacitance –Schering's, Measurement of frequency-Wien's bridge.

Calibration of Ammeter, Voltmeter and Wattmeter using DC potentiometers.

High voltage and high current in DC measurements- voltmeters, Sphere gaps, DC Hall effect sensors.

Module 4

Magnetic Measurements: Measurement of flux and permeability - flux meter, BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer – principle- determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses.

Measurement luminous intensity-Photoconductive Transducers-Photovoltaic cells

Temperature sensors-Resistance temperature detectors-negative temperature coefficient Thermistors-thermocouples-silicon temperature sensors.

Module 5

Transducers - Definition and classification. LVDT, Electromagnetic and Ultrasonic flow meters, Piezoelectric transducers-modes of operation-force transducer, Load cell, Strain gauge.

Oscilloscopes- Principal of operation of general purpose CRO-basics of vertical and horizontal deflection system, sweep generator etc. DSO-Characteristics-Probes and Probing techniques.

Digital voltmeters and frequency meters using electronic counters, DMM, Clamp on meters.

Phasor Measurement Unit (PMU) (description only).

Introduction to Virtual Instrumentation systems- Simulation software's (description only)

Text Books

1. Sawhney A.K., A course in Electrical and Electronic Measurements & instrumentation, DhanpatRai.
2. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria& Sons
3. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012
4. S Tumanski, Principles of electrical measurement, Taylor & Francis.
5. David A Bell, Electronic Instrumentation and Measurements,3/e, Oxford

Reference Books

1. Golding E.W., Electrical Measurements & Measuring Instruments, Wheeler Pub.
2. Cooper W.D., Modern Electronics Instrumentation, Prentice Hall of India
3. Stout M.B., Basic Electrical Measurements, Prentice Hall
4. Oliver & Cage, Electronic Measurements & Instrumentation, McGraw Hill
5. E.O Doebelin and D.N Manik, Doebelin's Measurements Systems, sixth edition, McGraw Hill Education (India) Pvt. Ltd.
6. P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

Course Contents and Lecture Schedule

Module	Topic coverage	No. of Lectures	No of hours
1	**General principles of measurements and classification of meters**		
1.1	Measurement standards–Errors-Types of Errors- Statistics of errors, Need for calibration.	3	**10**
1.2	Classification of instruments, secondary instruments– indicating, integrating and recording- operating forces -	1	
1.3	Essentials of indicating instruments - deflecting, damping, controlling torques.	3	
1.4	Ammeters and voltmeters - moving coil, moving iron, constructional details and operation, principles shunts and multipliers – extension of range.	3	
2	**Measurement of Resistance, Power and Energy**		
2.1	Measurement of power: Dynamometer type wattmeter – Construction and working - 3-phase power measurement- Low Powerfactorwattmeters.	3	**09**
2.2	Measurement of energy: Induction type watt-hour meters- Single phase energy meter – construction and working, two element three phase energy meters, Digital Energymeters - Time of Day (TOD) and Smart metering (description only).	3	
2.3	Current transformers and potential transformers – principle of working -ratio and phase angle errors. Extension of range using instrument transformers, Hall effect multipliers.	3	
3	**Measurement of circuit parameters using bridges, High voltage and high current measurements**		
3.1	Classification of resistance, low resistance, Ammeter voltmeter method, Kelvin's double bridge Medium resistance- Ammeter voltmeter method - Wheatstones bridge High resistance- loss of charge method- measurement of earth resistance.	3	**09**
3.2	Measurement of self inductance-Maxwell's Inductance bridgeMeasurement of capacitance–Schering's bridge Measurement of frequency-Wien's bridge.	2	
3.3	Calibration of Ammeter, Voltmeter and Wattmeter using DC potentiometers.	2	
3.4	High voltage and high current in DC measurements- voltmeters, Sphere gaps, DC Hall effect sensors.	2	

4	**Magnetic, Lumen and Temperature Measurements**		
4.1	Measurement of flux and permeability - flux meter, BH curve and permeability measurement - hysteresis measurement	2	**08**
4.2	Ballistic galvanometer – principle- determination of BH curve - hysteresis loop. Lloyd Fisher square - measurement of iron losses.	2	
4.3	Measurement luminous intensity-Photoconductive Transducers-Photovoltaic cells	2	
4.4	Temperature sensors-Resistance temperature detectors-negative temperature coefficient Thermistors-thermocouples-silicon temperature sensors.	2	
5	**Transducers and Digital instruments including modern recording and displaying instruments**		
5.1	Transducers - Definition and classification. LVDT, Electromagnetic and Ultrasonic flow meters, Piezoelectric transducers-modes of operation-force transducer, Load cell, Strain gauge.	2	**09**
5.2	Oscilloscopes- Principal of operation of general purpose CRO-basics of vertical and horizontal deflection system, sweep generator etc. DSO-Characteristics-Probes and Probing techniques.	3	
5.3	Digital voltmeters and frequency meters using electronic counters, DMM, Clamp on meters.	2	
5.4	Phasor Measurement Unit (PMU) (description only). Introduction to Virtual Instrumentation systems-Simulation software's (description only)	2	

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EET205	**ANALOG ELECTRONICS**	PCC	3	1	0	4

Prerequisite: Fundamentals of Electronics and semiconductor devices

CO 1	Design biasing scheme for transistor circuits.
CO 2	Model BJT and FET amplifier circuits.
CO 3	Identify a power amplifier with appropriate specifications for electronic circuit applications.
CO 4	Describe the operation of oscillator circuits using BJT.
CO 5	Explain the basic concepts of Operational amplifier(OPAMP)
CO 6	Design and developvarious OPAMP application circuits.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2									
CO 2	2	2	2									
CO 3			1	2								
CO 4	2	2	2									
CO 5			1	2								
CO 6	2	2	2									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	50
Apply	20	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 5 marks for each question. Students should answer all questions. Part B contains Fivesections, Each section have 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

Part A : 10 Questions x 5 marks=50 marks,

Part B : 5 Questions x 10 marks =50 marks

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the different types of biasing methods.(K1,K2)
2. Comment on the effect of Bandwidth and slew rate in Op-amp performance.
3. Draw the Small signal equivalent of differential amplifier and derive the equations for Input resistance, Voltage gain, CMRR.

Course Outcome 2 (CO2):

1. Analyse JFET and MOSFET characteristics.
2. Choose a power amplifier with appropriate specifications for electronic circuit applications.
3. List the features of Instrumentation amplifier.
4. What are the various op-amp feedback configurations? Explain each.
5. Explain the following op-amp circuits with neat sketches also find the output voltage equations
   - **a.** Summing amplifiers
   - **b.** Scaling amplifiers
   - **c.** Averaging amplifiers

Course Outcome 3(CO3):

1. Discuss the different feedback topologies.
2. Analyse the properties of an ideal op-amp.
3. Describe the working of Voltage to current converter using op-amp.
4. Draw the circuit diagrams for Log and antilog amplifier and obtain its output equations.
5. With necessary waveforms and neat diagram explain the working of Schmitt Trigger.
6. Design a Wein Bridge oscillator for a gain of 3 and oscillating frequency of 2kHz.

Course Outcome 4 (CO4):

1. Draw the Small signal equivalent of differential amplifier and derive the equations for Input resistance, Voltage gain, CMRR. (K1, K2)
2. Design various basic op-amp circuits. (K2)
3. Explain the following op-amp circuits with neat sketches also find the output voltage equations
   - **a.** Summing amplifiers
   - **b.** Scaling amplifiers(K2,K3)

Course Outcome 5 (CO5):

1. Generate different desired waveforms using op-amp.(K2,K3)
2. Draw the internal block diagram of 555 Timer IC and explain.(K1)
3. Realise multivibrators using 555 IC. (K2,K3)

Course Outcome 6 (CO6):

1. Design and set up an opamp integrator circuit and plot the input and output waveforms.(K3)
2. Explain the working of a ramp generator circuit using opamp.(K2)

Model Question paper

PAGES: 2

Reg No.:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITYTHIRD SEMESTER B.TECH DEGREE EXAMINATION,

MONTH AND YEAR

Course Code: EET205

Course Name: ANALOG ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

1. With neat diagrams explain DC load lines in transistor. What is the significance of Q point?
2. Draw and explain the h parameter small signal low frequency model for BJT.
3. Explain the construction and operation of Enhancement type metal oxide semiconductor FET with neat diagrams.
4. Explain the drain characteristics of JFET and mark the pinch-off voltage
5. Discuss the advantages of negative feedback amplifier.
6. State and explain Barkhausen's criterion of oscillation.
7. Compare the Ideal and Practical characteristics of an op-amp
8. Design a three input summing amplifier using op-amp having gains 2, 3and 5 respectively for each input
9. Show the circuit diagram of an Ideal Differentiator using op-amp with corresponding input and output waveform.
10. Explain the operation of a square wave generator using op-amp.

PART B

Answeranyonefullquestionfromeachmodule.Eachquestioncarries14 Marks

Module1

11. Design a voltage divider bias circuit to operate from a 18V supply in which bias conditions are to be V_{CE}=V_E=6V and I_C=1.5mA. β=90. Also calculate the stability factor S. **(14)**

12. A CE amplifier has the h-parameters given by h_{ie}= 1000Ω, h_{re} = $2*10^{-4}$, h_{fe}=50, h_{0e}= 25µΩ. If both the load and source resistances are 1kΩ, determine the a) current gain and b) voltage gain. **(14)**

Module 2

13. (a) Sketch the frequency response curve of RC coupled amplifier and discuss methods to improve gain bandwidth product **(7)**

    (b) List the four parameters of JFET. Also obtain the mathematical expression for transconductance. **(7)**

14. (a) How a JFET common drain amplifier is designed using voltage divider biasing? **(5)**

    (b)Which are the internal capacitances of a BJT? How these are incorporated in the high frequency hybid pi model of BJT? **(9)**

Module 3

15. Define conversion efficiency of power amplifier. Prove that the maximum conversion efficiency of a series fed class A amplifier is 25%. **(14)**
16. With neat circuit diagrams, explain the working of a two-stage RC coupled amplifier and derive the output relation of each stage. **(14)**

Module 4

17. How do the open-loop voltage gain and closed loop voltage gain of an op-amp differ? What is the limiting value of output voltage of op amp circuit? **(14)**
18. (a) An input of 3V is fed to the non inverting terminal of an op-amp. The amplifier has R_1=10kΩ and R_f=10kΩ.Find the output voltage. **(7)**

    (b) Explain briefly about the following (i) CMRR (ii) Slew Rate **(7)**

Module 5

19. (a) What is the significance of UTP and LTP in Schmitt trigger circuits? **(7)**

    (b) What is a zero crossing detector? **(7)**

20. (a) Explain the functional block diagram of Timer IC555. **(7)**

    (b) Design an astablemultivibrator using 555 Timer for an output wave of 65% duty ratio at 1kHz frequency. **(7)**

Syllabus

Module 1

Bipolar Junction Transistors: Review of BJT characteristics- Operating point of BJT – Factors affecting stability of Q point. DC Biasing–Biasing circuits: fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only).Numerical problems. Bias compensation using diode and thermistor.

BJT Model- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier –Role of coupling capacitors and emitter bypass capacitor. Calculation of amplifier gains and impedances using h parameter equivalent circuit.

Module 2

Field Effect Transistors: Review of JFET and MOSFET(enhancement mode only) construction, working and characteristics- JFET common drain amplifier-Design using voltage divider biasing.

Frequency response of Amplifiers: Internal Capacitances at high frequency operations of BJT- Hybrid Pi model of BJT. Low and high frequency response of Common Emitter amplifier. Frequency response of CE amplifier, Gain bandwidth product.

Module 3

Multistage amplifiers: Direct, RC, transformer coupled Amplifiers, Applications.

Power amplifiers using BJT: Class A, Class B, Class AB, Class C and Class D. Conversion efficiency – derivation(Class A and Class B). Distortion in power amplifiers. Feedback in Amplifiers-Effect of positive and negative feedbacks.
Oscillators:Barkhausen'scriterion–RCoscillators(RCPhaseshiftoscillatorandWeinBridgeoscillator) –LC oscillators(Hartley and Colpitt's)– Derivation of frequency of oscillation- Crystal oscillator.

Module 4

Operational Amplifiers: Fundamental differential amplifier- Modes of operation.

Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741.

Open loop and Closed loop Configurations-Concept of virtual short. Negative feedback in Op-amps. Inverting and non- inverting amplifier circuits. Summing and difference amplifiers, Instrumentation amplifier.

Module 5

OP-AMP Circuits: Differentiator and Integrator circuits-practical circuits – Design –

Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311.

Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation.

Timer 555IC: Internal diagram of 555IC–Astable and Monostable multi-vibrators using 555 IC.

Text Books

1. Bell D. A., Electronic Devices and Circuits, Prentice Hall ofIndia, 2007.
2. Malvino A. and D. J. Bates, Electronic Principles7/e, Tata McGraw Hill, 2010.
3. Boylestad R. L. and L. Nashelsky,Electronic Devices and CircuitTheory, 10/e, PearsonEducation India, 2009.
4. Choudhury R.,LinearIntegrated Circuits, New AgeInternational Publishers. 2008.

Reference Books

3. Floyd T.L., Fundamentals of Analog Circuits,, Pearson Education, 2012.
4. Robert T. Paynter and John Clemons, Paynter's Introductory electronic devices & circuits, Prentice Hall Career & Technology, New Jersey.
5. Millman J. and C. C. Halkias,Integrated Electronics: Analog and Digital Circuits andSystems, Tata McGraw-Hill, 2010.
6. Streetman B. G. and S. Banerjee,Solid State Electronic Devices, Pearson Education Asia,2006.
7. Gayakward R. A., Op-Amps and LinearIntegrated Circuits, PHILearning Pvt.Ltd., 2012.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1		**10**
1.1	Bipolar Junction Transistors: Review of BJT characteristics	1
1.2	Operating point of BJT – Factors affecting stability of Q point.	1
1.3	Biasing circuits: fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only). Numerical problems.	4
1.4	Bias compensation using diode and thermistor.	1
1.5	BJT Model- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier	1
1.6	Role of coupling capacitors and emitter bypass capacitor.	1
1.7	Calculation of amplifier gains and impedances using h parameter equivalent circuit.	1
2		**8**
2.1	Field Effect Transistors: Review of JFET and MOSFET (enhancement mode)-construction, working and characteristics	2
2.2	JFET common drain amplifier-Design using voltage divider biasing.	1
2.3	FET as switch and voltage controlled resistance.	1
2.4	Frequency response of Amplifiers: Internal Capacitances at high frequency operations of BJT- Hybrid Pi model of BJT. Low and high frequency response of Common Emitter amplifier	3
2.5	Frequency response of CE amplifier, Gain bandwidth product	1
3		**9**
3.1	Multistage amplifiers: Direct, RC, Applications.	1
3.2	Transformer coupled Amplifiers, Applications.	1
3.3	Derivation of conversion efficiency of Class A and Class B amplifiers.	2

3.4	Class AB, Class C and Class D amplifiers. Distortion in power amplifiers(Class A, Class B, Class AB, Class C and Class D)	2
3.5	Oscillators: Barkhausen's criterion–RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) Derivation of frequency of oscillation	2
3.6	LC oscillators (Hartley and Colpitt's) – Derivation of frequency of oscillation- Crystal oscillator.	1
4		**10**
4.1	Operational Amplifiers: Fundamental differential amplifier- Modes of operation.	2
4.2	Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741.	3
4.3	Open loop and Closed loop Configurations-Concept of virtual short.	2
4.4	Negative feedback in Op-amps.	1
4.5	Inverting and non- inverting amplifier circuits	1
4.6	Summing and difference amplifiers, Instrumentation amplifier.	1
5		**8**
5.1	OP-AMP Circuits: Differentiator and Integrator circuits-practical circuits - Design	1
5.2	Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311.	2
5.3	Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation.	2
5.4	Timer 555IC: Internal diagram of 555IC–Astable and Monostable multi-vibrators using 555 IC.	3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EEL201	**CIRCUITS AND MEASUREMENTS LAB**	**PCC**	**0**	**0**	**3**	**2**

Preamble : This laboratory course is designed to train the students to familiarize and practice various measuring instruments and different transducers for measurement of physical parameters. Students will also be introduced to a team working environment where they develop the necessary skills for planning, preparing and implementing basic instrumentation systems.

Prerequisite : Basic Electrical Engineering

Course Outcomes : After the completion of the course the student will be able to

CO 1	Analyse voltage current relations of RLC circuits
CO 2	Verify DC network theorems by setting up various electric circuits
CO 3	Measure power in a single and three phase circuits by various methods
CO 4	Calibrate various meters used in electrical systems
CO 5	Determine magnetic characteristics of different electrical devices
CO 6	Analyse the characteristics of various types of transducer systems
CO 7	Determine electrical parameters using various bridges
CO 8	Analyse the performance of various electronic devices for an instrumentation systems and, to develop the team management and documentation capabilities.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2						2			3
CO 2	3	3	-	-	-	-	-	-	2	-	-	3
CO 3	3	3	-	-	-	-	-	-	2	-	-	3
CO 4	3	3	2	-	-	-	-	-	2	-	-	3
CO 5	3	3	-	-	-	-	-	-	2	-	-	3
CO 6	3	3	2	-	-	-	-	-	2	-	-	3
CO 7	3	3	-	-	-	-	-	-	2	-	-	3
CO 8	3	3	3	3	2	-	-	-	3	3	3	3

ASSESSMENT PATTERN:

Mark distribution:

Total Marks	CIE marks	ESE marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Course Project	Total
15	30	25	5	**75**

Internal Test Evaluation (Immediately before the second series test)

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks

(d) Viva voce : 20 marks

(e) Record : 5 Marks

General instructions : Practical examination is to be conducted immediately after the second series test after conducting 12 experiments from the list of experiments given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS:

(12 experiments are mandatory)

1. Verification of Superposition theorem and Thevenin's theorem**.**
2. Determination of impedance, admittance and power factor in RLC series/ parallel circuits.
3. 3-phase power measurement using one wattmeter and two-wattmeter methods, and determination of reactive/apparent power drawn.
4. Resistance measurement using Kelvin's Double Bridge and Wheatstone's Bridge and extension of range of voltmeters and ammeters.
5. Extension of instrument range by using Instrument transformers(CT and PT)
6. Calibration of ammeter, voltmeter, wattmeter using Potentiometers
7. Calibration of 1-phase Energy meter at various power factors (minimum 4 conditions)
8. Calibration of 3-phase Energy meter using standard wattmeter
9. Determination of B-H curve, μ-H curve and μ-B curve of a magnetic specimen
10. Measurement of Self inductance, Mutual inductance and Coupling coefficient of a 1-phase transformer
11. a. Measurement of Capacitance using AC bridge

    b. Setup an instrumentation amplifier using Opamps.
12. Determination of characteristics of LVDT, Strain gauge and Load-cell.
13. Determination of characteristics of Thermistor, Thermocouple and RTD
14. Verification of loading effect in ammeters and voltmeters with current measurement using Clamp on meter.

15. Demo Experiments/Simulation study:

(a) Measurement of energy using TOD meter

(b) Measurement of electrical variables using DSO

(c) Harmonic analysers

(d) Simulation of Circuits using software platform

(e) Computer interfaced measurements of circuit parameters.

Mandatory Group Project Work : Students have to do a mandatory micro project (group size not more than 5 students) to realise a functional instrumentation system. A report also is to be submitted. Performance can be evaluated along with the internal test and a maximum of 5 marks shall be awarded.

Example projects (Instrumentation system with sensors, alarm, display units etc)

1. Temperature Monitoring System.
2. Gas / Fire smoke Detection Systems.
3. Simulation using LabVIEW, PLC or Similar Softwares.

Reference Books:

1. A. K. Sawhney: A course in Electrical and Electronic Measurements & Instrumentation, Dhanpat Rai Publishers
2. J. B. Gupta: A course in Electrical & Electronic Measurement & Instrumentation., S. K. Kataria & Sons Publishers
3. Kalsi H. S.: Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi.

CODE EEL203	ANALOG ELECTRONICSLAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

CO 1	Use the various electronic instruments and for conducting experiments.
CO 2	Design and develop various electronic circuits using diodes and Zener diodes.
CO 3	Design and implement amplifier and oscillator circuits using BJT and JFET.
CO 4	Design and implement basic circuits using IC (OPAMP and 555 timers).
CO 5	Simulate electronic circuits using any circuit simulation software.
CO 6	Use PCB layout software for circuit design

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2								2			
CO 2	2	2	2						2			
CO 3	2	2	2						2			
CO 4	2	2	2						2			
CO 5	1	1			3				3			
CO 6	1				3				3			

LIST OF EXPERIMENTS

1. Measurement of current, voltage, frequencyand phase shift of signal in a RC network using oscilloscope.
2. Clipping circuits usingdiodes.
3. Clamping circuits usingdiodes.
4. Design and testing ofsimpleZener voltage regulator.
5. RC coupled amplifier using BJT in CE configuration-Measurement of gain, BW and plotting of frequencyresponse.
6. JFETamplifier-Measurement of gain, BW and plotting of frequencyresponse.
7. Op-amp circuits – Design and set up of invertingand non-inverting amplifier, scale changer, adder, integrator, and differentiator.
8. Op-amps circuits – Scale changer, adder, integrator, and differentiator.
9. Precision rectifierusingOp-amps.
10. Phase shift oscillator usingOp-amps.
11. Wein’sBridgeoscillator using Op-amps.
12. Waveform generation– Square, triangular andsaw tooth waveformgeneration usingOPAMPs.
13. Basic comparator and Schmitt triggercircuits using Op-amp (Use comparator ICs such as LM311).
14. Design and testing of series voltage regulator using Zenerdiode.
15. Astable and Monostable circuit using555IC.
16. RC phase shift oscillator using Op-amp.
17. Introductionto circuit simulation using any circuit simulation software.
18. Introduction to PCB layout software.

Text Books

1. Bell D. A., Electronic Devices and Circuits, Prentice Hall of India, 2007.
2. Malvino A. and D. J. Bates, Electronic Principles7/e, Tata McGraw Hill, 2010.
3. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e, Pearson Education India, 2009.
4. Choudhury R., Linear Integrated Circuits, New Age International Publishers. 2008.

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2. Robert T. Paynter and John Clemons, Paynter's Introductory electronic devices & circuits, Prentice Hall Career & Technology, New Jersey.
3. Millman J. and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill, 2010.

4. Gayakward R. A., Op-Amps and Linear Integrated Circuits, PHI Learning Pvt. Ltd., 2012.

Course Project: Students have to do a mandatory course project (group size not more than 4 students) using to realise a functional analog circuit on PCB. A maximum of 5 marks shall be awarded for this project (to be evaluated along with the final internal test). Report to be submitted.

Example projects:

1. Audio amplifier.
2. Electronic Pest Repellent Circuit.
3. Electronic Siren.

Assessment Pattern :

Mark distribution :

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Course Project	Total
15	30	25	5	75

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipment and troubleshooting) : 25 Marks

(d) Viva voce : 20 marks

(e) Record : 5 Marks

General instructions : Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

SEMESTER -3

MINOR

Syllabus

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
EET281	**ELECTRIC CIRCUITS**	**MINOR**	**3**	**1**	**0**	**4**

Preamble : This course deals with circuit theorems applied to dc and ac electric circuits. Steady and transient state response of electric circuits is discussed. Network analysis is introduced with network parameters and transfer functions. This course serves as the most important prerequisite of all many advanced courses in electrical engineering.

Prerequisite : **Basics of Electrical Engineering / Introduction to Electrical Engineering**

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Apply circuit theorems to simplify and solve DC and AC electric networks.
CO 2	Analyse dynamic DC circuitsand develop the complete response.
CO 3	Analyse coupled circuits in S-domain
CO 4	Analyse three-phase networks in Y and Δ configurations.
CO 5	Develop the representation of two-port networks using Z and Y parameter.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3										2
CO 2	3	3										2
CO 3	3	3										2
CO 4	3	3										2
CO 5	3	3										2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State and explain network theorems (K1)
2. Problems on solving circuits using network theorems. (K2, K3)

Course Outcome 2 (CO2):

1. Distinguish between the natural response and forced response. (K2, K3)
2. Problems on steady state and transient analysis of RL, RC and RLC series circuits with DC excitation and initial conditions. (K2, K3)

Course Outcome 3 (CO3):

1. Problems on mesh analysis,analysis of transformed circuits in s-domain (K2, K3).
2. Problems on nodal analysis,analysis of transformed circuits in s-domain (K2, K3).

Course Outcome 4 (CO4):

1. Problems on analysis of balanced Y and Δ configurations. (K2, K3)
2. Problems on analysis of unbalanced Y and Δ configurations. (K2, K3)

Course Outcome 5 (CO5):

1. Problems on finding Z and Y parameters of simple two port networks. (K2).
2. Derive the expression for Z parameters in terms of Y parameters. (K1).

Model Question paper

QP CODE: PAGES: 3

Reg. No:______________

Name:________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EET281
Course Name: ELECTRIC CIRCUITS

Max. Marks: 100 **Duration: 3 Hours**

PART A
Answer all Questions. Each question carries 3 Marks

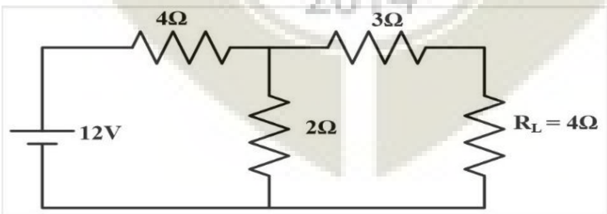
1. Compare the analogy between Nodal and Mesh analysis method.
2. State and explain superposition theorem with suitable examples.
3. Differentiate between transient and steady state analysis.
4. Explain Initial value and final value theorem.
5. Define Self-inductance, Mutual inductance and coupling coefficient.
6. Explain dot rule used in magnetically coupled circuits with the help of a neat figure.
7. Define the terms, real power, reactive power and apparent power.
8. Draw the circuit of a four-wire star connected three phase circuit and mark the lineand phase Voltage.
9. Differentiate driving point and transfer functions with respect to a two port network.
10. Draw the equivalent circuit representation in terms of Z-parameters. **(10 x 3=30)**

PART B

Answer any one full question from each module. Each question carries 14 Marks

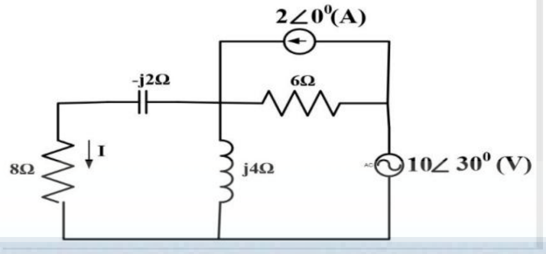
Module-1

11. (a) Draw the Thevenin's equivalent circuit and hence find the power dissipated across R_L **(8)**



(b)Compare the difference between dependent and independent sources. **(6)**

12. (a) Determine the power dissipated across 8Ω for the circuit shown by applying superpositiontheorem. **(10)**



(b) State and explain Thevenin'stheorem with suitable examples. **(4)**

Module-2

13. (a) The current through 5Ω resistor is **I(S) =(5S+3)/(S^2+5S+6).** Find the power dissipated across 5Ω resistor. **(7)**

(b) Derive the equation for the transient current flow through series RL circuit with DCsource and zero initial condition. **(7)**

14. (a) Derive the equation for the transient current flow through series RC circuit with DC source and zero initial condition. **(7)**

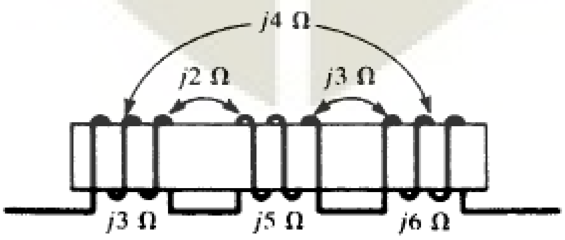
(b) Explain the term time constant with respect to series RL circuit with suitable figures. **(7)**

Module-3

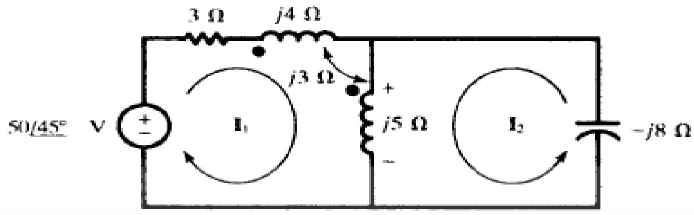
15. (a) In a series aiding connection, two coupled coils have an equivalent inductance LAand in a series opposing connection, the equivalent inductance is LB. Obtain an expression for M in terms of LA and LB. **(7)**

(b) Two coupled coils, L1 = 0.8 H and L2 = 0.2 H, have a coefficient of coupling k = 0:90. Find the mutual inductance M and the turns ratio N1/N2. **(7)**

16. (a) Obtain the dotted equivalent for the circuit shown and use the equivalent to find theequivalent inductive reactance. **(7)**



(b) In the circuit shown in figure, find the voltage across the 5 Ω reactance with the polarity shown. **(7)**



Module-4

17. (a) Explain two watt-meter method to measure the three phase power with the help of suitable equations. **(7)**

(b) Derive the relationship between the line and phase voltage in a three phase starconnected circuit. **(7)**

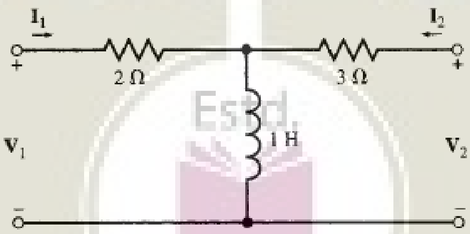
18. (a) A three-phase, three-wire, balanced, delta-connected load yields wattmeter readings of 154W and 557W. Obtain the load impedance, if the line voltage is 141.4 V. **(7)**

(b) Derive the relationship between the line and phase current of a three phase deltaconnected circuit.
(7)

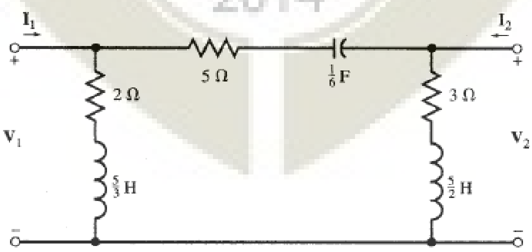
Module-5

19. (a) Derive the relationship between Z and Y parameters. **(6)**

(b) Find the Z-parameters of the two-port circuit. **(8)**



20. (a) Find the Y-parameters of the circuit. **(10)**



(b) Explain the condition for symmetry and reciprocity with respect to Z-parameters. **(4)**

Syllabus

Module 1

Circuit theorems: Review of Nodal and Mesh analysis method. DC and ACcircuits analysis with dependent and independent sources applying Network theorems – Superposition theorem, Thevenin's theorem.

Module 2

Steady state and transient response:Review of Laplace Transforms. DCresponseof RL, RC and RLC series circuitswith initial conditions and complete solution using Laplace Transforms- Time constant.

Module 3

Transformed circuits and analysis – Mutual inductance, coupling coefficient, dot rule. Analysis of coupled coils -– mesh analysis and node analysis of transformed circuits in S-domain.

Module 4

Three phase networks: Three phase power in sinusoidal steady state-complex power, apparent power and power triangle. Steady state analysis of three-phase three-wire and four-wire balanced and unbalanced Y circuits, Balanced and unbalanced Delta circuit. Three phase power measurement and two-wattmeter method.

Module 5

Two port networks: Driving point and transfer functions – Z and Y parameters.- Conditions for symmetry & reciprocity – Z and Y parameters. Relationshipbetween Z and Y parameters.

Text Books

1. Joseph A. Edminister and MahmoodNahvi, "Theory and Problems in Electric circuits", McGraw Hill, 5th Edition, 2010.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013

References:

21. Hayt and Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, New Delhi, 8th Ed, 2013.
2. Van Valkenberg, "Network Analysis", Prentice Hall India Learning Pvt. Ltd., 3 edition, 1980.
3. K. S. Suresh Kumar, "Electric Circuit Analysis", Pearson Publications, 2013.
4. Chakrabarti, "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018
5. R. Gupta, "Network Analysis and Synthesis", S. Chand & Company Ltd, 2010.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Circuit theorems(12 hours)**	
1.1	Review of Nodal analysis method.	2
1.2	Review of Mesh analysis method.	2
1.3	Dependent and independent current and voltage sources	2
1.4	Superposition theorem - Application to the analysis of DCand AC circuits with dependent and independent sources.	3
1.5	Thevenin's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	3
2	**Steady state and transient response. (9 hours)**	
2.1	Review of Laplace Transforms – Formulae of Laplace Transforms of common functions/signals, Initial value theorem and final value theorem, Inverse Laplace Transforms – partial fraction method.	3
2.2	DC response of RL series with initial conditions and complete solution using Laplace Transforms- Time constant	2
2.3	DC response of RC series with initial conditions and complete solution using Laplace Transforms- Time constant	2
2.4	DC response of RLC series with initial conditions and complete solution using Laplace Transforms- Time constant	2
3	**Transformed circuits and analysis (8 Hours)**	
3.1	Mutual inductance and Coupling Coefficient	2

3.2	Dot rule and polarity convention	1
3.3	Mesh analysis of transformed circuits in s-domain.	3
3.5	Nodalanalysis of transformed circuits in s-domain.	2
4	**Three phase networks. (9 Hours)**	
4.1	Three phase power in sinusoidal steady state-complex power, apparent power and power triangle.	2
4.2	Steady state analysis of three-phase three-wire and four-wire balanced and unbalanced Y circuits	3
4.3	Steady state analysis of three-phase three-wire and four-wire balanced and unbalanced Delta circuits.	2
4.4	Three phase power measurement and two-wattmeter method.	2
5	**Two port networks (7 Hours)**	
5.1	Two port networks: Terminals and Ports, Driving point and transfer functions.	2
5.2	Z –parameters. Equivalent circuit representation.	1
5.3	Y parameters. Equivalent circuit representation.	1
5.6	Conditions for symmetry & reciprocity- Z and Y-parameters	2
5.7	Relationship between Z and Yparameters.	1

Syllabus

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
EET 283	**INTRODUCTION TO POWER ENGINEERING**	**Minor**	**3**	**1**	**0**	**4**

Preamble : This course introduces various conventional energy sources. This course also introduces the design of transmission system and distributions system. It also introduces the economics of power generation.

Prerequisite : EST 130Basics of Electrical & Electronics Engineering

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Illustrate various conventional sources of energy generation
CO 2	Analyse the economics of power generation
CO 3	Analyse the economics of power factor improvement
CO 4	Design mechanical parameters of a transmission system.
CO 5	Design electrical parameters of a transmission system.
CO 6	Classify different types of ac and dc distribution systems.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3										2
CO 2	3	3										2
CO 3	3	3										2
CO 4	3	3										2
CO 5	3	3										2
CO 6	3	3										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Schematic and equipment of Conventional Power generation schemes (K1)
2. Comparison of various turbines associated with conventional generation (K2, K3)

Course Outcome 2 (CO2):

1. Definition and Calculation of various terms associated with power generation (K1, K2)
2. Problems on economics of power generation. (K2, K3)

Course Outcome 3 (CO3):

1. Problems on calculation of size of capacitors for power factor improvement (K2, K3).
2. Problems on economics of power factor placement (K2, K3).

Course Outcome 4 (CO4):

1. Derivation of various mechanical parameters associated with transmission line (K2, K3)
2. Derivation and problems of corona and insulators. (K2, K3).

Course Outcome 5 (CO5):

1. Derivation of various electrical parameters associated with transmission line (K2, K3).
2. Definition on transposition of line and changes in electrical parameters (K1,K2)

Course Outcome 6 (CO6):

1. Problems on AC and DC distribution systems (K2,K3).
2. Architecture and technologies in smart grid (K2,K3)

Model Question paper

QPCODE: PAGES:3

Reg.No:____________

Name :______________

APJABDULKALAMTECHNOLOGICALUNIVERSITY

FIRSTSEMESTERB.TECHDEGREEEXAMINATION, MONTH &YEAR

Course Code: EET 283

Course Name: Introduction to Power Engineering

Max.Marks:100 **Duration: 3Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What are the main differences between nuclear and thermal power plants?
2. How are turbines classified? How is a turbine selected for a site?
3. Explain the significance of Load factor and Load curve.
4. Discuss the disadvantages of low power factor in power system.
5. What is corona? Explain the factors have an influence on corona loss
6. High voltage is preferred for transmission. Discuss the merits and demerits of high voltage transmission.
7. Draw and explain the equivalent models of a medium transmission line.
8. What is transposition of lines? Comment on its necessity in the system.
9. Discuss the requirements of a distribution system.
10. Discuss the main features of an interconnected distribution system.

(10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Explain thegeneral arrangement of gas turbine power plant. **(8)**

    (b) Discuss the importance of small hydro power generation along with their advantages and disadvantages. **(6)**

12. (a) Explain various elements of a elements of diesel power plant **(8)**

(b) Explain the general layout of a nuclear power plant. **(6)**

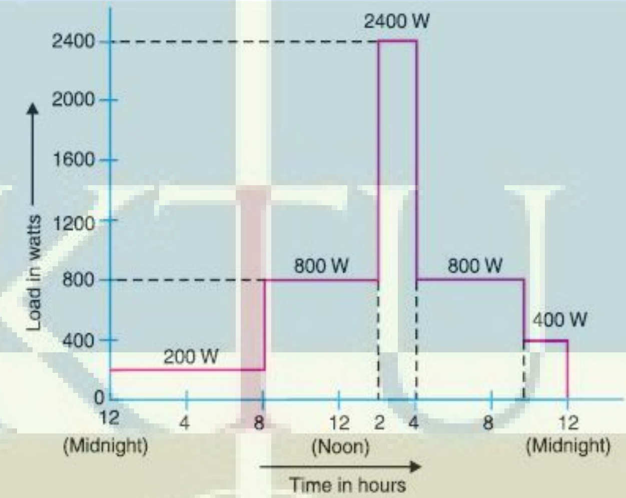
Module 2

13. (a)A generating station has a maximum demand of 150000 kW. The annual load factor is 50% and plant capacity factor is 40%. Determine the reserve capacity of the

plant. **(6)**

(b) The power factor in a three-phase plant with supply voltage of 400 V and absorbing an average power of 300 kW is 0.8. Determine the kVAr of the capacitor required to improve the power factor to 0.93. Determine the reduction in current drawn from the supply after installation of the capacitors. **(8)**

14. (a) Determine average demand and load factor of the load curve shown below **(7)**



(b) Explain any two methods of power factor improvement. **(7)**

Module 3

15. (a) Derive the equation for Sag in transmission lines, when the support is at equaland unequal heights. **(10)**

(b) Discuss the difference between disruptive critical corona and visual critical corona **(4)**

16. (a) In a 33 kV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of self-capacitance of each insulator, find (i) the distribution of voltage over 3 insulators and (ii) string efficiency. **(9)**

(b) Discuss various types of conductors used in power system. **(5)**

Module 4

17. (a) A 3 phase 70km long Transmission line has its conductors of 1 cm diameter spaced at the corners of the equilateral triangle of 100cm side. Find the inductance per phase of the system. **(6)**

(b) Derive loop inductance of a single phase two wire line. **(8)**

18. (a) The three conductors of a 3-phase line are arranged at the corners of a triangleof sides 2 m, 2·5 m and 4·5 m. Calculate the inductance per km of the line when the conductors areregularly transposed. The diameter of each conductor is 1·24 cm. **(6)**

(b)A single-phase transmission line has two parallel conductors 3 m apart,radius of each conductor being 1 cm. Calculate the capacitance of the line per km. **(8)**

Module 5

19. (a) Compare radial and ring main distribution system with the help of appropriate schematics. **(6)**

(b) A two conductor main, AB, 500m in length is fed from both ends at 250 V. Loads of 50A, 60A, 40A and 30A are tapped at distances of 100m, 250m, 350m and 400m from end A respectively. If the cross section of conductor is 1 cm^2 and specific resistance of the material is 1.7 μΩcm, determine the minimum consumer voltage. **(8)**

20. (a) A 2-wire dc distributor cable AB is 2 km long and supplies loads of 100A, 150A,200A and 50A situated 500 m, 1000 m, 1600 m and 2000 m from the feeding point A. Each conductor has a resistance of 0·01 Ω per 1000 m. Calculate the p.d. at each load point if a p.d. of 300 V is maintained at point A. **(7)**

(b) Explain the architecture of smart grid with the help of a schematic **(7)**

(14x5=70)

Syllabus

Module 1

Generation of power

Conventional sources**:** Hydroelectric Power Plants- Selection of site. General arrangement of hydel plant, Components of the plant, Classification of the hydel plants -Water turbines: Pelton wheel, Francis, Kaplan and propeller turbines, Small hydro generation.

Steam Power Plants: Working of steam plant, Power plant equipment and layout, Steam turbines

Diesel Power Plant: Elements of diesel power plant, applications

Gas Turbine Power Plant: Introduction Merits and demerits, selection site, fuels for gas turbines, General arrangement of simple gas turbine power plant, comparison of gas power plant with steam power plants

Nuclear Power Plants:Nuclear reaction, nuclear fission process, nuclear plant layout, Classification of reactors

Module 2

Economics of power generation

Types of loads, Load curve, terms and factors, peak load and base load

Cost of electrical energy – numerical problems

Power factor improvement – causes of low power factor, disadvantages - methods of power factor improvement, calculations of power factor correction, economics of power factor improvement

Module 3

Transmission system

Different types of transmission system - High voltage transmission - advantages

Mechanical design of overhead transmission line: Main components of overhead lines – types of conductors, line supports

Insulators–Types-String efficiency – methods of improving string efficiency

Corona – Critical disruptive voltage - Visual Critical Voltage – corona loss - Factors affecting corona, advantages and disadvantages, methods of reducing corona

Sag - calculation

Module 4

Electrical design of transmission line

Constants of transmission line – Resistance, inductance and capacitance

Inductance and capacitance of a single phase transmission line

Inductance and capacitance of a three phase transmission line with symmetrical and unsymmetrical spacing – transposition of lines

Module 5

Distribution system
Types of distribution systems
Types of DC distributors – calculations – distributor fed at one end and at both ends
Types of AC distributors – calculations

Smart Grid

Smart Grid – Introduction - challenges and benefits — architecture of smart grid introduction to IEC 61850 and smart substation

Text Books

Text Books:

1. D P Kothari and I Nagrath, "Power System Engineering," 2/e Tata McGraw Hills, 2008.
2. Wadhwa, “Electrical Power system”, Wiley Eastern Ltd. 2005.

References:

1. A.Chakrabarti, ML.Soni, P.V.Gupta, V .S.Bhatnagar, “A text book of Power system Engineering” DhanpatRai, 2000.
2. Grainer J.J, Stevenson W.D, “Power system Analysis”, McGraw Hill.
3. I.J.Nagarath& D.P. Kothari, “Power System Engineering”, TMH Publication.
4. A Stuart Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC Press, 2013.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Conventional energy sources (9 hours)**	
1.1	Introduction and history ofpower generation	1
1.2	Hydel power plant- Schematic, components and turbines	2
1.2	Steam power plant – Schematic, components and turbines	2
1.3	Schematic and various turbines with diesel and GT power generation	3
1.4	Nuclear power generation	1
2	**Economics of power generation and power factor improvement (8 hours)**	
2.1	Important terms associated with power generation such as load factor, load curve, etc	1

2.2	Numerical problems on the economics of generation.	2
2.3	Significance of power factor in power system	1
2.4	Methods of power factor improvement	2
2.5	Numerical problems on capacitor value evaluation and economics of power factor improvement	2
3	**Transmission System (10 Hours)**	
3.1	Introduction to transmission systems	1
3.2	Mechanical design of transmission lines- line supports and conductors	2
3.3	Types of insulators	1
3.4	String Efficiency, Methods of improving string efficiency, Numerical problems	2
3.5	Corona - Critical disruptive voltage : Visual Critical Voltage –corona loss	1
3.6	Factor affecting corona and corona loss, Numerical problems on corona	2
3.7	Sag in transmission lines	1
4	**Electrical parameters of a transmission line (9 Hours)**	
4.1	Introduction to constants of transmission line	1
4.2	Derivation of inductance and capacitance of a single phase transmission line	2
4.3	Derivation of Inductance and capacitance of a three phase transmission line with symmetrical and unsymmetrical spacing, transposition of lines	3
4..4	Numerical problems on inductance, capacitance of transmission lines	3
5	**Distribution systems (9 Hours)**	
5.1	Introduction to distribution system	1
5.2	DC distribution system – various types	2
5.3	Numerical Examples of DC distribution system	1
5.4	AC distribution system – various types	2
5.5	Numerical Examples of DC distribution system	2
5.6	Introduction to smart grid	1

Syllabus

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
EET 285	DYNAMIC CIRCUITS AND SYSTEMS	Minor	3	1	0	4

Preamble : This course introduces the application of circuit analysis techniques to dc and ac electric circuits. Analysis of electric circuits both in steady state and dynamic conditions are discussed. Network analysis using network parameters and transfer functions is also included .

Prerequisite : **Basics of Electrical Engineering / Introduction to Electrical Engineering**

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Apply circuit theorems to simplify and solve complex DC and AC electric networks.
CO 2	Analyse dynamic DC and AC circuits and develop the complete response to excitations.
CO 3	Solve dynamic circuits by applying transformation to s-domain.
CO 4	Solve series /parallel resonant circuits.
CO 5	Develop the representation of two-port networks using network parameters and analyse the network.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3										2
CO 2	3	3										2
CO 3	3	3										2
CO 4	3	3										2
CO 5	3	3										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. State and explain network theorems (K1)
2. Problems on solving circuits using network theorems. (K2, K3)

Course Outcome 2 (CO 2):

1. Distinguish between the natural response and forced response. (K2, K3)
2. Problems related to steady state and transient analysis of RL, RC and RLC series circuits with DC excitation and initial conditions. (K2, K3)
3. Problems related to steady state and transient analysis of RL, RC and RLC series circuits with sinusoidal excitation. (K2, K3)

Course Outcome 3 (CO 3):

1. Problems related to mesh analysis and node analysis of transformed circuits in s-domain (K2, K3).
2. Problems related to solution of transformed circuits including mutually coupled circuits in s-domain (K2, K3).

Course Outcome 4 (CO 4):

1. Define Bandwidth, and draw the frequency dependence of impedance of an RLC network. (K1).
2. Develop the impedance/admittance Vs frequency plot for the given RLC network. (K2).
3. Evalutate the parameters such as quality factor, bandwidth,

Course Outcome 5 (CO 5):

1. Problems to find Z, Y, h and T parameters of simple two port networks. (K2).
2. Derive the expression for Z parameters in terms of T parameters. (K1).
3. Show that the overall transmission parameter matrix for cascaded 2 port network is simply the matrix product of transmission parameters for each individual 2 port network in cascade. (K1).

Model Question paper

QP CODE:

PAGES:2

Reg. No:______________
Name:______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH. DEGREE EXAMINATION

Course Code: EET 285
Course Name: DYNAMIC CIRCUITS AND SYSTEMS

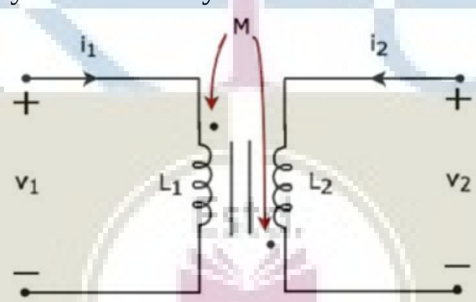
Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1. What is the condition for transferring maximum power to load in an ac network? How is it obtained?
2. State and explain the reciprocity theorem.
3. Derive an expression for calculating the steady state current when an ac is applied to a series RL circuit.
4. A voltage of $v(t) = 10 \cos(1000t + 60^0)$ is applied to a series RLC circuit in which R=10Ω, L=0.02H and $C=10^{-4}$ F. Find the steady current.
5. Apply KVL in both primary and secondary circuits and write the corresponding equations.



6. Give the transform representation in s-domain of an inductor with initial current and transform representation in s-domain of a capacitor with initial voltage.
7. Compare series and parallel resonance on the basis of resonant frequency, impedance and bandwidth.
8. How is selectivity measured in a parallel resonant circuit? How is selectivity increased?
9. What are the conditions for reciprocity of a two port network in terms of z parameters? What are the similar conditions in terms of y parameters?
10. How do we find equivalent T network of a two port network if z parameters are given?

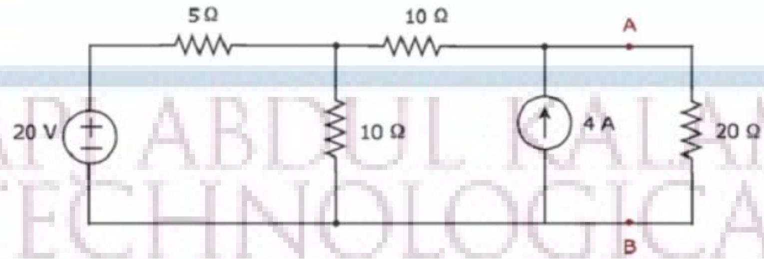
(10 x 3 = 30)

PART B

Answer any one full question, each carries14 marks.

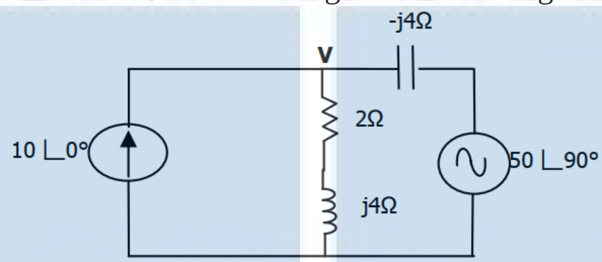
MODULE1

11. a) Find the current through the 20Ω resistor using Norton's theorem. **(6)**



b) State and prove maximum power transfer theorem. **(8)**

12. a) Use superposition theorem to find the voltage V shown in figure. **(8)**



b)State Thevenin's theorem. How is Thevenin equivalent circuit developed? **(6)**

MODULE II

13. a)Write the dynamic equations for analyzing the behavior of step response of a series RLC circuit. **(7)**

b) A sinusoidal voltage 25 sin 10t is applied at time t=0 to a series RL circuit comprising of R=5 Ω, L = 1 H. Using Laplace transformation, find an expression for instantaneous current in the circuit. **(7)**

14. a) A voltage 10 cos (1000t + 60^0) is applied to a series RLC circuit comprising of R=10 Ω, L = 0.02 H, C = 10^{-4} F. Find an expression for the steady state current in the circuit. **(7)**

b) A capacitor C having capacitance of 0.2 F is initially charged to 10 volts and it is connected to an RL series circuit comprising of R=4Ω and L = 1 H, by means of a switch at time t=0. Find the current through the circuit by means of Laplace transformation method. **(7)**

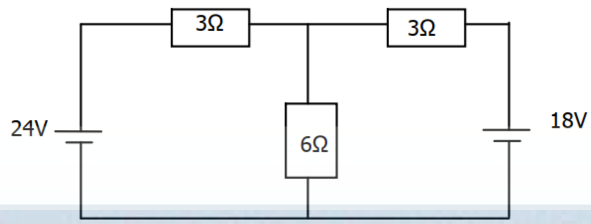
MODULE III

15. a) An LC network comprises of series inductor branches L1 and L2 each of inductance 2 H and parallel capacitor branches C1 and C2 each with capacitance 1 F. Find the transform impedance Z(s). **(6)**

b) What are reciprocal networks? What are the conditions that should be satisfied by a network to be reciprocal? **(8)**

16. a) How is transfer function representation of a network function helpful in analyzing the behavior of the network? Mention the significance of poles and zeros in network functions? **(8)**

b)Using Laplace transformation, find the current in the 6 Ω resistor. **(6)**



MODULE IV

17. a) In a series RLC circuit, for frequencies more than the resonant frequency, what nature of reactance is exhibited? Substantiate the reason for the answer. **(6)**

b) A series RLC circuit consists of R= 25 Ω, L = 0.01 H, C = 0.04 μF. Calculate the resonant frequency. If 10 V is applied to the circuit at resonant frequency, calculate the voltages across L and C. Find the frequencies at which these voltages are maximum. **(8)**

18. a) A coil of resistance 20 ohm and inductance of 200 mH is connected in parallel with a variable capacitor. This combination is connected in series with a resistance of 8000 ohm. Supply voltage is 200 V, 50Hz. Calculate the following

i) The value of C at resonance

ii) The Q of the coil

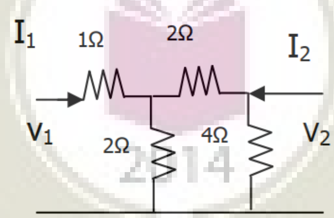
iii) Dynamic resistance of the circuit. **(7)**

b) Derive expressions for selectivity and bandwidth of a parallel tuned circuit. **(7)**

MODULE V

19. a) A two port network has the following z parameters: z_{11}=10 Ω, z_{12}=z_{21}=5 Ω, z_{22} = 12 Ω. Evaluate the y parameters for the network. **(8)**

b)Find the z parameters of the network given. **(6)**



20. a)For the given two-port network equations, draw an equivalent network. $I_1 = 5V_1 - V_2$; $I_2 = -V_2 + V_1$.

(7)

b) A symmetrical T-network has the following open-circuit and short-circuit impedances:

Z_{oc}= 800Ω (open circuit impedance)

Z_{sc}= 600Ω(short circuit impedance)

Calculate impedance values of the network. **(7)**

Syllabus

Module 1

Circuit theorems: DC and Sinusoidal steady state analysis of circuits with dependent and independent sources applying Superposition principle, Source transformation, Thevenin's, Norton's and Maximum Power Transfer theorems - Reciprocity theorem.

Module 2

Analysis of first and second order dynamic circuits: Formulation of dynamic equations of RL, RC and RLC series and parallel networks with dc excitation and initial conditions and complete solution using Laplace Transforms - Time constant - Complete solution of RL, RC and RLC circuits with sinusoidal excitation using Laplace Transforms – Damping ratio – Over damped, under damped, critically damped and undamped RLC networks.

Module 3

Transformed circuits in s-domain: Transform impedance/admittance of R, L and C - Mesh analysis and node analysis of transformed circuits in s-domain. Transfer Function representation – Poles and zeros.

Analysis of Coupled Circuits: – Dot polarity convention – Sinusoidal steady state analysis of coupled circuits - Linear Transformer as a coupled circuit - Analysis of coupled circuits in s-domain.

Module 4

Resonance in Series and Parallel Circuits:

Resonance in Series and Parallel RLC circuits – Quality factor – Bandwidth – Impedance Vs Frequency, Admittance Vs Frequency, Phase angle Vs frequency for series resonant circuit.

Module 5

Two port networks: Driving point and transfer functions – Z, Y, h and T parameters - Conditions for symmetry & reciprocity – relationship between parameter sets – interconnections of two port networks (series, parallel and cascade) — T-π transformation.

Text Books

1. Joseph A. Edminister and MahmoodNahvi, "Theory and Problems in Electric circuits", McGraw Hill, 5th Edition, 2010.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013

References:

1. Hayt and Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, New Delhi, 8th Ed, 2013.
2. Van Valkenberg, "Network Analysis", Prentice Hall India Learning Pvt. Ltd., 3 edition, 1980.
3. K. S. Suresh Kumar, "Electric Circuit Analysis", Pearson Publications, 2013.
4. Chakrabarti, "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018
5. R. Gupta, "Network Analysis and Synthesis", S. Chand & Company Ltd, 2010.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Network theorems - DC and AC steady state analysis (12 hours)**	
1.1	Linearity and Superposition principle - Application to the analysis of DC and AC (sinusoidal excitation) circuits. Application of source transformation in electric circuit analysis.	2
1.2	Thevenin's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	3
1.3	Norton's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	3
1.4	Maximum power transfer theorem - DC and AC steady state analysis with dependent and independent sources.	2
1.5	Reciprocity Theorem - Application to the analysis of DC and AC Circuits.	2
2	**First order and second order dynamic circuits. (9 hours)**	
2.1	Review of Laplace Transforms – Formulae of Laplace Transforms of common functions/signals, Initial value theorem and final value theorem, Inverse Laplace Transforms – partial fraction method. *(Questions to evaluate the Laplace/inverse transforms of any function / partial fractions method shall not be given in tests/final examination. Problems with application to circuits can be given).*	2
2.2	Formulation of dynamic equations of RL series and parallel networks and solution using Laplace Transforms – with DC excitation and initial conditions. Natural response and forced response. Time constant.	1

2.3	Formulation of dynamic equations of RC series networks and solution using Laplace Transforms – with DC excitation and initial conditions. Natural response and forced response. Time constant.	1
2.4	Formulation of dynamic equations of RLC series networks with DC excitation and initial conditions, and solution using Laplace Transforms – Natural response and forced response. Damping coefficient. Underdamped, Overdamped, critically damped and undamped cases.	1
2.5	Formulation of dynamic equations of RL, RC and RLC series networks and solution with sinusoidal excitation. Complete solution (Solution using Laplace transforms).	2
2.6	Formulation of dynamic equations of RL, RC and RLC parallel networks and solution using Laplace Transforms – with DC and Sinusoidal excitations. Damping ratio.	2
3	**Transformed Circuits in s-domain and Coupled circuits (9 Hours)**	
3.1	Transformed circuits in s-domain: Transformation of elements (R, L, and C) with and without initial conditions.	2
3.2	Mesh analysis of transformed circuits in s-domain.	1
3.3	Node analysis of transformed circuits in s-domain.	1
3.4	Transfer Function representation – Poles and zeros.	1
3.5	Analysis of coupled circuits: mutual inductance – Coupling Coefficient-Dot polarity convention — Conductively coupled equivalent circuits. Linear Transformer as a coupled circuit.	2
3.6	Analysis of coupled circuits in s-domain.	2
4	**Resonance in Series and Parallel Circuits. (6 Hours)**	
4.1	Resonance in Series and Parallel RLC circuits –Related problems	3
4.2	Quality factor – Bandwidth –	1
4.3	Impedance Vs Frequency, Admittance Vs Frequency and Phase angle Vs frequency for series resonant circuit.	2

5	**Two port networks (9 Hours)**	
5.1	Two port networks: Terminals and Ports, Driving point and transfer functions. Voltage transfer ratio, Current transfer ratio, transfer impedance, transfer admittance, poles and zeros.	2
5.2	Z –parameters. Equivalent circuit representation.	1
5.3	Y parameters. Equivalent circuit representation.	1
5.4	h parameters. Equivalent circuit representation.	1
5.5	T parameters.	1
5.6	Conditions for symmetry & reciprocity, relationship between network parameter sets.	1
5.7	Interconnections of two port networks (series, parallel and cascade).	1
5.8	T-π Transformation.	1