Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	EEC-210	Electrical Machines - II	4		4
PC	EEC-212	Power Systems - I	4		4
PC	ECC-218	Electronics - II	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-256	Electrical Machines - II Lab		2	1
PC	EEC-260	Power Systems - I Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
PC	ECC-264	Electronics - II Lab		2	1
Total			**21**	**10**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Paper Code(s): BS-202	L	P	C
Paper: Probability, Statistics and Linear Programming	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for solving linear programming problems.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to formulate and solve linear programming problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.

Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.

Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the

Central Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

Unit III

Hypotheses Testing for a SingleSample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviationof a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference forTwo Samples.
Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR.

Unit IV

Linear Programming: Introduction, formulation of problem, Graphical method, Canonical and Standard form of LPP, Simplex method, Duality concept, Dual simplex method, Transportation and Assignment problem.

Textbooks:

1. *Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018
2. *Linear Programming* by G. Hadley, Narosa, 2002

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10th Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.
6. *Operations Research: An Introduction* by Hamdy A. Taha, Pearson, 10th Edition, 2016

Paper Code(s): EEC-206	L	P	C
Paper: Network Analysis and Synthesis	3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand the LTI system and wave form synthesis.
2.	To understand mathematical modelling of circuit.
3.	To understand two port parameter and transfer function.
4.	To understand realization of passive network and filter.

Course Outcome (CO):

CO 1	Ability to determine function from waveform.
CO 2	Ability to determine transient respond of circuit.
CO 3	Ability to determine two port parameter of circuit.
CO 4	Ability to realize the circuit from their transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Introduction to signals, their classification and properties, different types of systems, LTI systems and their properties, periodic waveforms and signal synthesis, properties and applications of Laplace transform of complex waveform. [T1,T2]

UNIT-II

System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform. [T1,T2]

UNIT-III

Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.
Two port networks – Introduction of two port parameters and their interconversion, interconnection of two 2-port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial. [T1,T2]

UNIT IV

Positive real function and synthesis of LC, RC, RL Networks in Foster's I and II, Cauer's I& II forms, Introduction of passive filter and their classification, frequency response, characteristic impedance of low pass, high pass, Band Pass and Band reject prototype section. [T1,T2]

Textbook(s):

1. W H Hayt "Engineering Circuit Analysis" TMH Eighth Edition
2. Kuo, "Network analysis and synthesis" John Weily and Sons, 2nd Edition.

Reference Books:

1. S Salivahanan "Circuit Theory" Vikas Publishing House 1st Edition 2014
2. Van Valkenburg, " Network analysis" PHI, 2000.
3. Bhise, Chadda, Kulshreshtha, " Engineering network analysis and filter design" Umesh publication, 2000.
4. D. R. Choudhary, "Networks and Systems" New Age International, 1999
5. Allan H Robbins, W.C.Miller "Circuit Analysis theory and Practice"Cengage Learning Pub 5th Edition 2013
6. Bell "Electric Circuit" Oxford Publications 7th Edition.

Paper Code(s): EEC-210	L	P	C
Paper: Electrical Machines – II	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of synchronous generator.
2.	To understand the concept of three phase induction motor.
3.	To understand the concept of synchronous motor.
4.	To understand the concept of single phase motor.

Course Outcomes (CO)

CO 1	Ability to analyse the synchronous generator.
CO 2	Ability to analyse ofthree phase induction motor
CO 3	Ability to analyse ofsynchronous motor.
CO 4	Ability to analyse ofsingle phase motor.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

Unit I

Synchronous Alternators Constructional features, armature windings, E.M.F. equation, winding coefficients, harmonics in the induced E.M.F., armature reaction, O.C. and S.C. tests, voltage regulation-Synchronous impedance method, MMF Method, Potier's triangle method parallel operation, operation on infinite bus, cooling. Two reaction theory, power expressions for cylindrical and salient pole machines, performance characteristics. [T1,T2]

Unit II

Poly phase Induction Machines Constructional features, production of rotating magnetic field, working of 3-phase Induction motor, phasor diagram, equivalent circuit, power and torque relations, torque and slip relations, no load and blocked rotor tests and efficiency. speed control by rotor resistance, injected e.m.f, frequency variation and pole changing, DOL, Y-Δ and autotransformer starters, deep bar and double cage rotor motors, cogging and crawling, operation of Induction machine as generator and phasor diagram. [T1,T2]

Unit III

Synchronous Motors – Principle of operation, starting methods, phasor diagram torque-angle characteristics,

V-curves hunting and damping, synchronous condenser, introduction to single phase synchronous motors: Reluctance and Hysteresis motors. [T1,T2]

Unit IV

Fractional Horse Power Motors Single Phase Induction Motor: Double revolving field theory, equivalent circuit, no load and blocked rotor tests, starting methods, split phase Induction motor- capacitor start, two value capacitor motor.

Introduction and applications of single phase AC series motor, universal motor, AC servo motor, stepper motor, permanent magnet AC motors. [T1,T2]

Textbook(s):

1. A Fitzgeral, Charles Kingsley, Stephen Umans, "Electric Machinery", Tata McGraw Hill Education, 6th Edition, 2002
2. I J Nagrath D P Kothari, "Electric Machines", McGraw-Hill Education, 3rd edition, 2011.

Reference Books:

1. The Performance and Design of Alternating Current Machines, M.G. Say, CBS Publishers, 2005
2. Oblems in Electrical Engineering: Power engineering and electronics with answers Partly Solved in I. Units: Parker Smith , CBS Publishers, 9th edition, 2003
3. Electric Machines, I J Nagrath D P Kothari, Mc Graw-Hill Education, 3rd edition, 2011
4. Samarjit Ghosh, "Electrical Machines", Pearson

Paper Code(s): EEC-212	L	P	C
Paper: Power Systems – I	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of transmission line parameter.
2.	To impart the knowledge of transmission line.
3.	To impart the knowledge of cables.
4.	To impart the knowledge of load flow studies.

Course Outcomes (CO)

CO 1	Ability to calculate the transmission line parameters.
CO 2	Ability to analyse performance of transmission line.
CO 3	Ability to understand working of cables.
CO 4	Ability to solve load flow in power system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Power System Components: Block diagram of electric power system, Single line diagram of power system, brief description of power system elements such as, synchronous machine, transformer, transmission line, bus bar and circuit breaker.

Transmission line: Configurations, type of conductors, Mechanical Design of Transmission Line: catenary curve, calculation of sag and tension, effects of wind and ice loadings on sag, sag template, vibration dampers. Overhead Lines Insulators: Types of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential. [T1,T2]

UNIT II

Overhead Transmission Lines: Corona and Interference: Phenomenon of corona, corona loss, factors affecting corona, methods of reducing corona, bundle conductors and interference.

Calculation of resistance (skin & proximity effects), inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines. Modeling and performance analysis of short, medium and long transmission line. Ferranti effect, Transposition of transmission conductors, surge impedance loading. Introduction and analysis of travelling wave use of Bewley Diagram. [T1,T2]

UNIT III

Insulated Cables: Types of cables, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables.
Fault Analysis: Per unit system, symmetrical component, calculation of symmetrical and unsymmetrical fault, use of current limiting reactors. [T1,T2]

UNIT IV

Power Flow Analysis: Formulation of Y-bus Matrix, Power flow equations, Classification of buses, Data for load flow, Gauss-Seidal Method, acceleration factor of convergence; Newton Raphson Method Fast Decoupled load flow; Comparison of power Flow Methods. [T1,T2]

Textbook(s):

1. C.L.Wadhava, "Electrical Power Systems", New Age International, 2004
2. Hadi Saddat, "Electric power systems", Tata McGraw Hill. 2014.

Reference Books:

1. S. L. Uppal, "Electrical Power", Khanna Publishers, 13th edition 2003
2. W. H. Stevension, "Elements of Power System Analysis", McGraw Hill, 1982
3. Ashfaq Hussain, "Electrical Power System" CBS Publishers and Distributors.

Paper Code(s): ECC-218	L	P	C
Paper: Electronics – II	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working of amplifier circuits.
2.	To understand the working of multi-stage, feedback and power amplifier.
3.	To understand working of operational amplifier and linear applications.
4.	To understand the function of waveform generators.

Course Outcomes (CO)

CO 1	Ability to solve problems related to amplifier circuits.
CO 2	Ability to apply the amplifiers circuits in real world.
CO 3	Ability to analyse various operational amplifier circuits.
CO 4	Ability to understand the function of various waveform generators.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT – I

BJT, FET MOSFET Bias stabilization: Need for stabilization, fixed Bias, emitter bias, self-bias, bias stability with respect to variations in ICO, Small signal amplifiers:, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain & impedance, comparisons of different configurations, Emitter follower, Darlington pair(derive voltage gain, current gain, input and output impedance). [T1]

UNIT – II

Multistage Amplifiers
Feedback Amplifiers: Feedback concept, Classification of Feedback amplifiers, Properties of negative Feedback amplifiers, Impedance considerations in different Configurations,
Power Amplifiers: Power dissipations in transistors, Amplifiers Classification, (Class-A, Class-B, Class-C, Class-AB) Efficiency analysis, Push-pull and complementary Push-pull amplifiers. [T1]

UNIT – III

Linear & Non Linear Wave shaping: , Inverting and non-inverting amplifiers, voltage follower, difference amp, adders, Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision

rectifiers(half & full wave),peak detector, Inverting & non inverting Schmitt trigger circuit.
Waveform generations: Sine wave generator (Phase shift, Wein bridge, Hartley & Colpitts), Barkhausen criteria of oscillations, conditions for oscillation, crystal oscillator. [T2]

UNIT IV

Waveform generators: Square and triangular waveform generators (determine period and frequency), saw tooth wave generator, Astable multi-vibrator, Monostable and Bistable Multivibrator.
Active RC Filters: Idealistic & Realistic response of filters (LPF, BPF, HPF, BRF), Butter worth & Chebyshev approximation filter functions All pass, Notch Filter. [T2]

Textbook(s):

1. Salivahanan , Suresh Kumar, Vallavaraj, "Electronic Devices and Circuits" TMH, 1999
2. D. Roy Choudhary, Shail B Jain, "Linear Integrated Circuits" New Age Publisher, 1999.

Reference Books:

1. B. Kumar ,Shail Bala Jain, "Electronic Devices and Circuits" PHI.
2. M.Rashid , "Microelectronic Circuit", Cengage Learning Publication.
3. Sedra & Smith, "Micro Electronic Circuits" Oxford University Press, 2000
4. David A Bell, "Operational Amplifiers and Linear IC's", PHI.

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