Electrical and Electronics Engineering Program

Preamble: The curriculum of B. Tech. (Electrical and Electronics Engineering) program offered by the Department of Electrical And Electronics Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like IEEE and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes facilitating the learners to achieve their Professional and Career Accomplishments.

The Vision

To be a hub for imparting knowledge, skills and behaviour for exemplary contributions in the field of Electrical & Electronics Engineering

The Mission

- To impart technical education through the state of the art infrastructural facilities, laboratories and instruction
- To inculcate industry oriented learning through industrial visits, internships, projects at industries, MOUs, to make students technically skilled oriented
- Creating conductive environment for higher education, employment and entrepreneurship through quality education, professional skills and research
- To promote societal commitment among students by inculcating moral and ethical values

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Electrical and Electronics Engineering of NSRIT will

1. Demonstrate the real-world engineering problem solving skills by applying the fundamental and conceptual engineering knowledge as a practicing Electrical and Electronics engineer or as a member/lead in a multidisciplinary project setting that utilize 21st century skills

2. Provide research-based engineering solutions addressing the triple bottom line of environment and sustainability maintaining the professional standards, ethics and integrity

3. Foster self-directed learning through their professional experience, technology advancements in their relevant field of interest and desiring graduates pursue advanced higher education leading to research

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behaviour with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Electrical and Electronics Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioural competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and write effectively reports, presentation and give / receive clears instructions (Communication)

11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Analyze, design and simulate diverse problems associated in the field of electrical, electronics and computer based systems by providing sustainable solutions adopting ethical practices
2. Apply appropriate methods and modern components to aid design, analysis and synthesis of solutions

Category-wise Credit Distribution of Courses

Category		AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	21.0
ES	Engineering Science	24.0	22.5	22.5
PC	Professional Core	48.0	55.5	52.5
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
Total no. of credits		160	160	160

Electrical and Electronics Engineering

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards		
	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

No.	Code	Course	POs	Contact Hours				
				L	T[1*]	P	C	
Semester I								
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[1]	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX03	Basic Electrical Engineering	1	3	0	0	3.0	ES
05	20ESX02	Programming for Problem Solving Using 'C'	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Lab	10	0	0	3	1.5	HS
07	20BSX34	Applied Physics Lab	1, 4	0	0	3	1.5	BS
08	20ESX07	Programming for Problem Solving Using 'C' Lab	1, 4	0	0	3	1.5	ES
			Sub-total	15	02	09	**19.5**	
Semester II								
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20CS403	Python Programming	1	3	1	0	3.0	ES
04	20ESX04	Engineering Mechanics	1	3	1	0	3.0	ES
05	20ESX01	Engineering Drawing	1, 5, 10	1	0	4	3.0	ES
06	20BSX24	Applied Chemistry Lab	1, 4	0	0	3	1.5	BS
07	20CS407	Python Programming Lab	1	0	0	3	1.5	ES
08	20ESX06	Engineering Workshop	4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	2	0	0	-	MC
			Sub-total	15	04	13	**19.5**	
Semester III								
01	20BSX13	Numerical Methods and Transforms	1	3	1	0	3.0	BS
02	20EC302	Electronic Devices and Circuits	1, 3, 10	3	0	0	3.0	PC
03	20EE303	Electrical Circuit Analysis	1, 3, 10, PSO 1	3	1	0	3.0	PC
04	20EE304	DC Machines and Transformers	2,3, PSO 1	3	0	0	3.0	PC
05	20EE305	Power Generation and Transmission	2, 7, 10, PSO 1	3	0	0	3.0	PC
06	20EC306	Electronic Devices and Circuits Lab	4, PSO 1	0	0	3	1.5	PC
07	20EE307	DC Machines and Transformers Lab	4, PSO 1	0	0	3	1.5	PC
08	20EE308	Electrical Circuit Analysis Lab	4, PSO 1	0	0	3	1.5	PC
09	20EES01	MATLAB	5	1	0	2	2.0	SC
10	20MCX02	Constitution of India	-	2	0	0	-	MC
			Sub-total	18	02	11	**21.5**	

*Suggested hours for tutorial

[1]By default all courses are mapped to PO 12 as they are weakly contributing

No.	Code	Course	POs	Contact Hours				
				L	T	P	C	
Semester IV								
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20BSX15	Probability and Statistics	1	3	1	0	3.0	BS
03	20EE403	Control Systems	3, PSO 1	3	0	0	3.0	PC
04	20EE404	Induction Motors and Synchronous Machines	2, 3, PSO 1	3	1	0	3.0	PC
05	20EE405	Electro Magnetic Field Theory	3, PSO 1	3	0	0	3.0	ES
06	20EE406	Induction Motors and Synchronous Machines Lab	4	0	0	3	1.5	PC
07	20EE407	Industrial Automation for Electrical & Electronics Engg.	4	0	0	3	1.5	PC
08	20EE408	Control Systems Lab	4, PSO 1	0	0	3	1.5	PC
09	20EES02	Programmable Logic Circuits	3, 4	1	0	2	2.0	SC
			Sub-total	16	02	11	**21.5**	
Semester V								
01	20EE501	Power Distribution and Distributed Generation	2, 3, 7, PSO 1	3	0	0	3.0	PC
02	20EE502	Power Electronics	2, 3, PSO 1	3	1	0	3.0	PC
03	20EC305	Digital System Design	1, 3	3	0	0	3.0	PC
04	-	Professional Elective I	-	3	0	0	3.0	PE
05	-	Open Elective I	-	3	0	0	3.0	OE
06	20EC308	Digital System Design Lab	4	0	0	3	1.5	PC
07	20EE507	Power Electronics Lab	4, PSO 1	0	0	3	1.5	PC
08	-	MOOCs	12	0	0	0	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents	-	2	0	0	-	MC
10	-	Summer Internship #1[2]	5, 8, 9, 10, PSO 1	0	0	0	1.5	IN
11	-	Technical Paper Writing	-	0	0	2	-	AC
			Sub-total	17	01	08	**21.5**	
Semester VI								
01	20EC603	Micro Processors and Micro Controllers	3	3	0	0	3.0	PC
02	20EE602	Electrical Measurements and Instrumentation	2, PSO 1	3	0	0	3.0	PC
03	20EE603	Power System Analysis	2, 3, 6, PSO 1	3	1	0	3.0	PC
04	-	Professional Elective II	-	3	0	0	3.0	PE
05	-	Open Elective II	-	3	0	0	3.0	OE
06	20EC606	Micro Processors and Micro Controllers Lab	4, 9	0	0	3	1.5	PC
07	20EE607	Electrical Measurements and Instrumentation Lab	4, PSO1	0	0	3	1.5	PC
08	20EE608	Power Systems and Simulation Lab	4, PSO1	0	0	3	1.5	PC
09	20EES04	P-SPICE	5	1	0	2	2.0	SC
10	20MCX04	Indian Traditional Knowledge	-	2	0	0	-	MC
			Sub-total	18	01	11	**21.5**	
Semester VII								
01	-	Professional Elective III	-	3	0	0	3.0	PE
02	-	Professional Elective IV	-	3	0	0	3.0	PE
03	-	Professional Elective V	-	3	0	0	3.0	PE
04	-	Open Elective III	-	3	0	0	3.0	OE
05	-	Open Elective IV	-	3	0	0	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20EES05	E-CAD	5	1	0	2	2.0	SC
08	-	Summer Internship #2[2]	5, 8, 9, 10, PSO 1	0	0	0	3.0	IN
			Sub-total	19	0	02	**23.0**	
Semester VIII								
01	-	Full Semester Internship[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
02	-	Capstone Project[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
			Sub-total	0	0	0	**12.0**	
			Total Credits	-	-	-	**160**	

[2] The work pertaining to Summer Internship #1 and #2 shall be completed at the end of Semesters IV and VI respectively. The assessment shall be carried out during Semesters V and VII

[3] The students opting for FSI in VII Semester should take up the courses of VII Semester in VIII Semester

List of Electives

Professional Elective #1								
1	20EE001	Low Power Electronics Design	-	3	0	0	3.0	PE
2	20EE002	Digital Control Systems	-	3	0	0	3.0	PE
3	20EE003	Utilization of Electrical Energy	-	3	0	0	3.0	PE
4	20EE004	Machine Modelling and Analysis	-	3	0	0	3.0	PE
5	20EE005	Sensors and Transducers	-	3	0	0	3.0	PE
Professional Elective #2								
6	20EE006	Solid State Electric Drives	-	3	0	0	3.0	PE
7	20EE007	Advanced Control Systems	-	3	0	0	3.0	PE
8	20EE008	Reactive Power Compensation and Management	-	3	0	0	3.0	PE
9	20EE009	Switchgear Protection	-	3	0	0	3.0	PE
10	20EE010	Process Instrumentation	-	3	0	0	3.0	PE
Professional Elective #3								
11	20EE011	Industrial Electronics	-	3	0	0	3.0	PE
12	20EE012	Digital Signal Processing	-	3	0	0	3.0	PE
13	20EE013	Power System Operation and Control	-	3	0	0	3.0	PE
14	20EE014	Programmable Control Devices and Applications	-	3	0	0	3.0	PE
15	20EE015	Virtual Instrumentation	-	3	0	0	3.0	PE
Professional Elective #4								
16	20EE016	Analysis of Power Converters	-	3	0	0	3.0	PE
17	20EE017	Multivariable Control System	-	3	0	0	3.0	PE
18	20EE018	HVDC and FACTS	-	3	0	0	3.0	PE
19	20EE019	Automotive Electrical Engineering	-	3	0	0	3.0	PE
20	20EE020	Wireless Sensors and Instrument Networks	-	3	0	0	3.0	PE
Professional Elective #5								
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.								PE
Open Elective #1								
21	20CEO01	Urban Environmental Service	-	3	0	0	3.0	OE
22	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
23	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
24	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
25	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
26	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
27	20MEO01	Nano Technology	-	3	0	0	3.0	OE
28	20SHO01	Women and Society	-	3	0	0	3.0	OE
Open Elective #2								
29	20CEO02	Ecology, Environment and Resources	-	3	0	0	3.0	OE
30	20CS004	Internet of Things	-	3	0	0	3.0	OE
31	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
32	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
33	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
34	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
35	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE
36	20SHO02	Design the Thinking	-	3	0	0	3.0	OE
Open Elective #3								
37	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
38	20CS302	Operating Systems	-	3	0	0	3.0	OE
39	20AIO03	Intelligent Robots and Drone Technology	-	3	0	0	3.0	OE
40	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
41	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
42	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
43	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
Open Elective #4								

The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.								OE
B. Tech. (Honors)								
Category I								
1	20EEH01	Smart Electrical Vehicles	-	4	0	0	4.0	HO
2	20EEH02	Advanced Smart Power Grids	-	4	0	0	4.0	HO
3	20EEH03	Power Quality	-	4	0	0	4.0	HO
Category II								
4	20EEH04	Energy Storage Management	-	4	0	0	4.0	HO
5	20EEH05	Energy Audit Conversation and Management	-	4	0	0	4.0	HO
6	20EEH06	Electrical Load Estimation	-	4	0	0	4.0	HO
Category III								
7	20EEH07	Green Energy Model	-	4	0	0	4.0	HO
8	20EEH08	Optimization Techniques	-	4	0	0	4.0	HO
9	20EEH09	Illumination Engineering	-	4	0	0	4.0	HO
Category IV								
10	20EEH10	Dynamics of Electrical Machines	-	4	0	0	4.0	HO
11	20EEH11	Advanced Power System Protection	-	4	0	0	4.0	HO
12	20EEH12	Power System Stability	-	4	0	0	4.0	HO
B. Tech. (Minor with Specialization)								
Category I								
1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E-Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Fundamentals of Electronics	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI
Category II								
8	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
9	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
10	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
11	20EEM02	Basics of Electrical Machines and Drives	-	3	0	0	3.0	MI
12	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
13	20AIM02	Machine Learning with Python	-	3	0	0	3.0	MI
14	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI
Category IIII								
15	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
16	20CSM03	Database Security	-	3	0	0	3.0	MI
17	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
18	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
19	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
20	20AIM03	Interpretable Deep Learning	-	3	0	0	3.0	MI
21	20DSM03	Data Governance	-	3	0	0	3.0	MI

List of Honors offered by Electrical and Electronics Engineering Program

1. Smart Electrical Vehicles
2. Advanced Power Systems
3. Advanced Power Quality

List of Minor with Specialization offered by Electrical and Electronics Engineering Program

1. Basics of Electrical Drives and Control

BS 20BSX13 Numerical Methods and Transforms 3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX13.1	Calculate the approximate roots of the algebraic equations & Transcendental equations by different techniques	3	1	L1, L2, L3
20BSX13.2	Make use of the concepts of interpolation to estimate the unknown functional values	3	1	L1, L2, L3
20BSX13.3	Find approximate values of finite integrals using different numerical techniques and use different algorithms for approximating solutions of ordinary differential equation to its analytical computations.	3	1	L1, L2, L3
20BSX13.4	Apply the Laplace transform to solve ordinary differential equations with initial conditions.	3	1	L1, L2, L3
20BSX13.5	Solve engineering problems using Fourier Transforms	3	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Solutions of Algebraic and Transcendental Equations **11+1 Hours**

Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method– Jacobi and Gauss-Seidel methods solving system of equations.

Convergence of – Bisection method, Secant method, Method of false position Newton - Raphson Method

Unit II: Interpolation. **11+1 Hours**

Introduction –– Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula**.**

Errors in Polynomial Interpolation – Error Propagation in a Difference Table- Numerical differentiations

Unit III: Numerical integration and solution of ordinary differential equations. **11+1 Hours**

Numerical integration**:** Trapezoidal rule – Simpson's 1/3rd and 3/8th rule

Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method.

Runge-Kutta method (second order)

Unit IV: Laplace Transforms **11+1 Hours**

Laplace Transforms of Standard Functions - Shifting Theorems –Transforms of Derivatives and Integrals – Multiplication by $t^n - Division\ by\ t$ –Unit Step Function -Unit Impulse function-Laplace Transforms of Periodic Functions- Inverse Laplace Transforms - Convolution Theorem (Without Proof).

Applications: Solving Ordinary Differential Equation (Initial Value Problems) using Laplace Transforms.

Unit Step Function -Unit Impulse function

Unit V: Fourier Transforms **11+1 Hours**

Fourier Transforms**:** Fourier Integrals - Fourier Cosine and Sine Integrals - Fourier Transform- Sine and Cosine Transform – Properties-Inverse Fourier Transforms.

*Finite Fourier Sine Transforms***,** *Finite Fourier Cosine Transforms, Inverse Finite Fourier Transforms.*

Textbooks:

1. Grewal. B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018
2. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Education, 2018

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015
2. Bali. N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018.
3. Peter O' Neil," Advanced Engineering Mathematics",8th Edition, Cengage, 2017.
4. Iyenger.T.K.V,Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Engineering Mathematics II& III ",S. Chand publications, 2nd Edition ,2019.

Web References:

1. https://nptel.ac.in/courses/122/102/122102009/
2. https://nptel.ac.in/courses/111/106/111106139/
3. https://nptel.ac.in/courses/111/102/111102129/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	50	40
L3	30	40
Total (%)	100	100

L1: Remember

1. Identify the root lies between which values for $\mathbf{x^3 - 5x + 1 = 0}$
2. Prove that $(1+\Delta)(\mathbf{1 - \nabla})=1$
3. Find the First difference of the polynomial $x^4-12x^3+42x^2-30x+9$ with interval of Differencing h=2.
4. Define unit step function
5. State Convolution theorem

L2: Understand

1. Find a real root of xtanx+1=0 using false position method.
2. Find a real root of the equation xe^x-cosx=0 using Newtons-Raphson method.
3. Use Gauss backward interpolation formula to find f(32) given that f(25)=0.2707 f(30)=0.3027 ,f(35)=0.3386, f(40)=0.3794
4. Using Lagrange's formula find the value of f(1) given that

x	-2	-1	2	7
y	-1	0	4	11

5. Find $\int_0^1 \frac{1}{1+x}$ dx by (i) Trapezoidal rule (ii) Simpsons $\frac{1}{3}$rd rule (iii) Simpsons $\frac{3}{8}$th rule.

L3: Apply

1. Using Newton Raphson method compute $\sqrt[3]{\mathbf{37}}$ correct to 4 decimal places
2. Find $\sqrt{\mathbf{12}}$ & $\frac{\mathbf{1}}{\sqrt{\mathbf{12}}}$ by the fixed point iteration method
3. The population of a nation in the decimal census was given below .Estimate the population in the year 1925 using appropriate interpolation formula

Year x	1891	1901	1911	1921	1931
Population y	46	66	81	93	101

4. Given that $Sin45^0$ =0.7077, $Sin50^0$ = 0.766, $Sin55^0$ =0.8192, $Sin60^0$ =0.866 find $Sin40^0$ using Newton's forward difference formula.
5. Solve $y^1=y-x^2$,y(0)=1 using picard's method up to fourth approximation.

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Chairman
Board of Studies (EEE)

PC 20EC302 Electronic Devices and Circuits 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO3	PO10	
20EC302.1	Explain the operation and characteristics of PN junction diode and special diodes.	2	-	1	L1,L2
20EC302.2	Classify, Analyze and design different types of rectifiers.	1	3	2	L2,L3,L4
20EC302.3	Compute the flow of current in different configurations of the transistor.	1	-	2	L1,L2
20EC302.4	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers.	1	3	2	L2,L3,L4
20EC302.5	Design small signal low frequency transistor amplifiers.	1	3	2	L2,L3,L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Junction Diode Characteristics **12 Hours**

Open circuited PN junction, Biased PN junction, current components in PN junction Diode, diode current equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance, energy band diagram of PN junction Diode, Quantitative theory of PN junction diode.

Diode switching times, PN diode clipping circuits.

Unit II: Special Semiconductor Diodes and Rectifiers **12 Hours**

Zener Diode, Breakdown mechanisms, Zener diode applications, Construction, operation and characteristics of LED, Photo diode, Tunnel Diode, SCR, UJT. Operation, Derivations of parameters of rectifiers, Input and output waveforms of half wave rectifier, Full wave rectifier and bridge rectifier, Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

Liquid crystal display (LCD), Pin diode, LC filter.

Unit III: Transistor Characteristics **12 Hours**

BJT: Junction transistor, Transistor current components, Transistor equation, Transistor configurations, Transistor as an amplifier and characteristics of transistor in CB, CE and CC configurations, Ebers-Moll model of a transistor, Punch through/reach through, Photo transistor, Typical transistor junction voltage values.

FET: JFET- types, Construction, Operation, Characteristics and parameters, MOSFET-types, Construction, Operation and characteristics, Comparison between JFET and MOSFET.

Transistor switching times, FET working as voltage variable resistor.

Unit IV: Transistor Biasing and Thermal Stabilization **12 Hours**

Need for biasing, operating point, Load line analysis, BJT biasing methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S, S', S''), Thermistor and Sensistor bias compensation techniques, Thermal runaway, Thermal stability, JFET Biasing methods and stabilization.

Diode compensation technique, transistor compensation technique.

Unit V: Small Signal Low Frequency Transistor Amplifier Models **12 Hours**

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Conversion of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB, CE and CC amplifiers, Comparison of transistor amplifiers.

FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, Comparison of FET amplifiers.

Effects of emitter bypass capacitor (C_e) on low frequency response.

Text Books

1. Lal Kishore K, "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016.
2. Millman J, Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010.
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 5th Edition, 2009.
4. Boylestad R.L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009.

Reference Books

1. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012.
2. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.
3. J. Millman, C. Halkias, "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009.
4. B. P. Singh, Rekha, Electronic Devices and Integrated Circuits, Pearson publications, 3rd Edition, 2009.
5. Mittal G.K., "Electronic Devices and Circuits", 3rd Edition, Khannan Publishers, 2008.

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	20	20
L3	30	30
L4	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define cut-in Voltage
2. What is diffusion capacitance?
3. What is break down voltage?
4. List any three applications of SCR
5. Define pinch off voltage
6. What is rectifier?
7. Define ripple factor
8. Give any two applications of full wave rectifier
9. Give the classification of filters
10. Write any two disadvantages of half wave rectifier

L2: Understand

1. Draw and explain V-I characteristics of PN junction diode
2. Describe the construction and operation of tunnel diode
3. With neat circuit diagram describe the operation of bridge rectifier
4. Explain why Zener diode is used in reverse bias with the help of characteristics
5. Draw and explain the input and output Characteristics of Common base configuration
6. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
7. Write a short note on (i) Thermal Runaway (ii) Thermal stability
8. Explain the Drain and transfer characteristics of n-Channel JFET
9. With the help of diagram explain self bias method of JFET
10. Explain thermister compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expression for voltage divider bias method of JFET
6. With the help of circuit diagram explain voltage divider bias method of JFET
7. Give the comparison of BJT, JFET and MOSFET
8. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier
9. Obtain the expressions for voltage gain and current gain of small signal low frequency common source amplifier

L4: Analyze

1. Derive the equation for ripple factor for half wave rectifier with capacitor filter
2. Determine the peak load voltage, peak current and power dissipation in a 495Ω load resistor connected to a bridge rectifier circuit that has a 26 V ac input. The rectifier diodes are germanium
3. Derive the equation for ripple factor of half wave rectifier with LC filter
4. Derive the expression for stability factor for voltage divider bias of BJT
5. Derive the expression for stability factor for self bias of JFET
6. For the fixed bias circuit R_B = 150 kΩ and R_B = 100 kΩ. Calculate I_B, I_C and V_{CE} if V_{CC} = 12 V, R_C =1.1 kΩ and β = 100 and also state the region of operation
7. Analyse the h-parameters from transistor characteristics
8. Discuss the analysis for small signal model of JFET
9. Analyse the h-parameters of common base amplifier
10. Investigate the h-parameters of common drain amplifier

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PC 20EE303 Electrical Circuit Analysis 3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO3	PO10	PSO 1	
20EE303.1	Demonstrate R-L-C circuits using different techniques.	3	3	2	1	L1,L2,L3
20EE303.2	Examine R-L-C circuits using Sinusoidal excitation and 3-Phase circuits with Balanced and Un-Balanced loads.	3	3	2	1	L1,L2,L3
20EE303.3	Illustrate the network theorems on electrical circuits.	3	3	2	1	L1,L2,L3
20EE303.4	Solve Two Port Networks and obtain different parameters for a given Two port Network.	3	3	2	1	L1,L2,L3
20EE303.5	Estimate the Transient behavior of electrical circuits using different approaches.	3	3	2	1	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Electrical Circuits: **11+1 Hour**

Network elements classification, Electric charge and current, Electric energy and potential, Resistance parameter series and parallel combination, Inductance parameter series and parallel combination, Capacitance parameter series and parallel combination. Energy sources: Ideal, Non-ideal, Independent and dependent sources, Source transformation, Kirchhoff's Laws, Mesh Analysis and Nodal analysis, Principal of Duality with examples.

Basic Concepts of passive elements of R, L, C and their V-I relations.

Unit II: Single Phase AC Circuits and Three – Phase AC Circuits: **11+1 Hour**

R.M.S, Average Values and Form Factor for Different Periodic Waveforms: Sinusoidal Alternating Quantities. Phase and Phase Difference, Complex and Polar Forms Of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) With Sinusoidal Excitation, Concept of Power Factor, Concept of Reactance, Impedance, Susceptance and Admittance-Real and Reactive Power and Complex Power.
Relation between Line and Phase Voltages and Currents, Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems, Mutual coupled circuits, Dot convention in coupled circuits.

Addition and subtraction of phasor, mathematical representation of sinusoidal quantities, Two wattmeter method for measurement of three phase power.

Unit III: Network Theorems (DC & AC Excitation): **11+1 Hour**

Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Superposition Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Milliman's Theorem and Compensation Theorem for circuits with independent and dependent sources.

Tellegens Theorem

Unit IV: Two Port Networks **11+1 Hour**

Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.

Concept of Duality and Dual Networks

Unit V: Transient Analysis in DC and AC circuits **11+1 Hours**

Transient response of R-L, R-C, R-L-C circuits using AC & DC excitations, solution using differential equations and Laplace transforms.

Solutions using Laplace transform method.

Textbooks

1. Alexander K and Mathew N.O.Sadiku, "Fundamentals of Electrical Circuits", 6th Edition, McGraw Hill Publications 2019
2. ME Van Valkenburg, "Network Analysis", 3rd Edition, Prentice Hall of India, 2000

Reference Books

1. Abhijit Chakrabarti, "Circuit Theory Analysis and Sythesis", 6th edition, Dhanpat Rai & Co., 2014
2. William Hayt and Jack E. Kemmerley, "Engineering Circuit Analysis", 6th edition, McGraw Hill Company, 2015
3. Sudhakar and Shyammohan S Palli, "Circuits & Networks", 5th Edition, Tata McGraw – hill Higher Education, , 2015

Web References:

1. https://nptel.ac.in/courses/108/106/108106172/
2. https://nptel.ac.in/courses/108/104/108104139/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	30
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

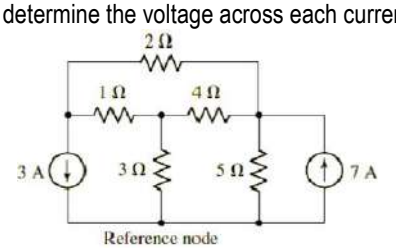
1. Classify the Network elements
2. Define Source Transformation with an example
3. State Principle of Duality
4. State Maximum Power transfer theorem and Compensation Theorem
5. Define Time constant of RL circuit

L2: Understand

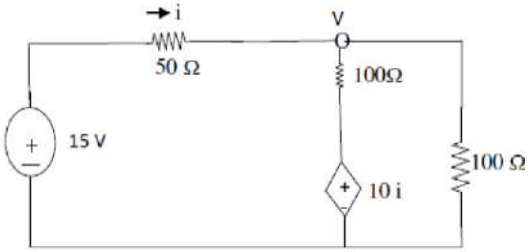
1. Explain the Transient response of RC circuit for AC excitation
2. Explain the concept of Impedance and Power Factor
3. Explain the Types of Energy Sources
4. Discuss the Principle of Duality
5. Explain the Cascading of Two port networks

L3: Apply

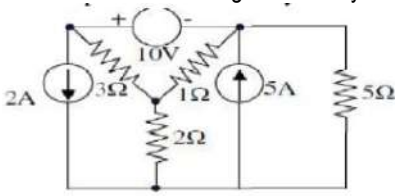
1. For the circuit shown in figure, determine the voltage across each current source



2. Using source transformation, find the voltage V in the circuit shown in figure



3. Find the power delivered by the 5A current source using nodal analysis



4. A resistance of 12 Ω and an inductance of 0.025 H are connected in series across a 50 Hz supply. What values of resistance and inductance when connected in parallel will have the same resultant impedance and pf? Find the current in each case when the supply voltage is 230 V?
5. Two inductively coupled coils have self inductances L1= 50mH and L2= 200mH. If the coefficient of coupling is 0.5 i) find the value of mutual inductance between the coils and ii) what is the maximum possible mutual inductance?

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PC 20EE304 DC Machines and Transformers 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping of PO's			DoK
		PO2	PO3	PSO 1	
20EE304.1	Understand the principle of electromagnetic energy conversion	-	-	3	L1, L2
20EE304.2	Evaluate the performance characteristics of various DC generators based on excitation	3	1	1	L1,L2,L3,L4
20EE304.3	Evaluate the performance characteristics of various DC Motors based on excitation	3	1	1	L1,L2,L3,L4
20EE304.4	Brief the construction of transformers, its Losses and regulation	1	1	1	L1, L2
20EE304.5	Design of three phase transformers to achieve phase conversion	2	3	1	L1,L2,L3,L4
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's					
L1: Remember | L2: Understand | L3: Apply | L4: Analyse | L5: Evaluate | L6: Create, DoK : Depth of Knowledge					

Unit I: Principles of Electromechanical Energy Conversion **11+1 Hour**

Energy in magnetic system, field energy and mechanical force, multiply-excited magnetic field systems, forces/torques in systems with permanent magnets, energy conversion via electric field, dynamical equations of electro mechanical systems

permanent magnets, and applications of permanent magnet materials.

Unit II: DC Generator **11+1 Hour**

Constructional details Principle of operation, Armature winding Lap & Wave, Emf equation, Methods of excitation, Armature Reaction, Commutation

Characteristics of D.C. Generators: O.C.C, internal-external characteristics, losses-power flow, efficiency calculation

Purpose Equalizer rings, Different methods of commutation

Unit III: DC Motors: **11+1 Hour**

Principle of operation of DC motors, Back EMF, Torque equation, Types of DC motors, Speed-Torque characteristics of DC motors

Speed Control & Testing of DC Machines:

Starting of DC motors: 3-point starter, 4-point starter, Losses and efficiency, Condition for maximum efficiency, Speed control methods, Brake test, Swinburne's test, Retardation test, Hopkinson's test, fields test.

Separation of iron and frictional losses

Unit IV: Transformers I **11+1 Hour**

Constructional features, Principle of operation, , EMF equation, Transformer on No load and Load Phasor diagram, equivalent circuit, Regulation, losses and efficiency, All day efficiency.

polarity test, back-to-back test

Unit V: Transformers II **11+1 Hour**

Open circuit and short circuit test, Sumpner's test, parallel operation, separation of core losses test, auto transformers, 3-Ø transformer connections, Scott connection

applications and comparison with two winding transformers, phase conversion topics

Text Books

1. Bhimbra P.S. "Electrical Machines", 4th Edition, Khanna Publishers, 2015
2. Theraja B.L., Theraja A.K., "A Textbook Of Electrical Technology: AC And DC Machines", volume 2, S Chand, 1999
3. A.E.Fitzgerald, Charles kingsley, Stephen D.Umans "Electric Machinery", 6th Edition, Tata McGraw-Hill 2013

Reference Books

1. Kothari D. P., Nagarth I .J., "Electrical Machines", 4th edition, Mc Graw Hill Publications, 2010
2. Rajput R.K. "Electrical Machines", 5th edition, Lakshmi publications, 2016
3. Mulukutla S.Sarma & Mukesh k.Pathak "Electric Machines", 4th Edition, CENGAGE Learning, 2012
4. Guptha J.B., "Theory & Performance of Electrical Machines", 6th Edition, S.K.Kataria & Sons, 2008

Web References

1. https://nptel.ac.in/courses/108/105/108105017/
2. https://www.youtube.com/watch?v=AECBgmkWvo0&list=PLbMVogVj5Njqbg9363J1uq5Fnq4m1Ygxl

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	30	40
L4	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is a back e.m.f? Why the e.m.f generated in the armature of a DC motors is called back emf
2. Discuss briefly the principle of energy conversion
3. List any three advantages of three – phase transformer over three single – phase transformers
4. Define voltage regulation of a transformer
5. Why OC test is performed on LV side of a single phase transformer?
6. Define all day efficiency of a single phase transformer?
7. Write the applications of series, shunt and compound DC motors
8. Why is armature control superior to field control scheme in case of a DC shunt motor
9. Why the main flux in a transformer is remains practically constant from no load to full load

L2: Understand

1. A 6-pole lap wound DC generator has 720 conductors; a flux of 80 mWb/poleis driven at 1000 rpm. Find the generated e.m.f.
2. Explain what would happen if the DC Motor is directly switched on to the supply without any starter
3. Distinguish between core type and shell type transformers
4. Explain the concept of Scott connection (three phase to two phase) conversion with a neat circuit diagram
5. Explain the effects of third harmonic component in a three phase transformer
6. Explain with relevant diagrams, the different methods of excitation of DC machines
7. Explain the speed torque characteristics of DC shunt, series and cumulative compound motors
8. Derive the emf equation of a transformer
9. Explain the significance of swinburne's test on dc machine?
10. Explain the necessity of commutating poles and compensating windings in a dc machine?
11. Explain the significance of interpoles in DC machines?

L3: Apply

1. Calculate (i) the total torque developed (ii) the useful torque of a 250 V, 4 pole series motor with 782 wave connected conductors developing 8 kW and taking 40 A with a flux per pole of 25 mWb. The armature resistance of the motor is 0.75 ohms
2. In a retardation test on a D.C motor, with its field normally excited, the speed fell from 1525 to 1475 in 25 seconds. With an average load of 1 kW supplied by the armature, the same speed drop occurred in 20 seconds. Find the moment of inertia of the rotating parts in kg.m2?
3. In a 400 V, 50 Hz transformer, the total iron loss is 2300 W. When the supply voltage and the frequency reduced to 200 V and 25 Hz respectively the corresponding loss is 800 W. Calculate the eddy current loss at normal voltage and frequency
4. A 2-winding 10 kVA, 440/110 V transformer is reconnected as a step-down 550/440 V autotransformer. Compare volt-ampere rating of the autotransformer with that of original 2-winding transformer. Calculate power transferred to the load: (i) inductively (ii) conductively
5. A balanced 3-phase, 100 kW load at 400V and 0.8 p.f. lag is to be obtained from a balanced 2-phase, 1100V lines. Determine the kVA rating of each unit of the Scott-connected transformer
6. A 20 kW, 250 V, 6 pole lap connected dc generator runs at 1250 rpm. Armature has 550 conductors. For full load armature – ohmic loss of 250 W, find the useful flux per pole. Take 2 V as the brush drop at full load
7. A DC series motor, with unsaturated magnetic circuit and negligible resistance, when running at a certain speed on a given load, takes 60 A at 600 V. If the load torque varies as the cube of the speed, find the resistance to be inserted to reduce the speed by 50 %.
8. A 4.5 kVA, 400/210 V,50 Hz single phase transformer has the following test data
   :O.C. test (l.v.side) 210V, 1A,70 W
   S.C. test (h.v.side) 15 V, 10.8A, 100 W
   Calculate (i) Equivalent circuit referred to l.v side and
   (ii) Secondary load voltage on full load at 0.8 power factor lagging
   (iii) Efficiency of transformer at ¾ th load and 0.7 power factor (lag).
9. A balanced 3-phase, 250 kW load at 415 V and 0.88 power factor lagging is to be supplied from a two – phase 1100 V supply. Determine voltage and current rating of each winding of scott connected transformers and kVA rating of each unit.
10. A 8 kW, 220 V, 4 – pole wave connected dc motor has 450 armature conductors. At full load, the useful flux per pole is 0.023 Wb and rotational losses are 110 W. Find the full load speed

L4: Analyse

1. In a DC generator, if the load increases the flux per pole decreases. Justify the statement
   How can determine the direction of rotation of a DC motor? And also explain how to change the direction of rotation?
2. Analyse the condition for maximum efficiency of any DC machine?

3. Draw and Analyse the load characteristics of a separately-excited dc generator
4. Analyse the purpose of using equalizing bars in parallel operation
5. Indirect test is superior to the direct test justify this statement with proof
6. A 22.38 kw, 440 V, 4-pole wave wound D.C. shunt motor has 840 armature conductors and 140 commutator segments. Its full-load efficiency is 88% and the shunt field current is 1.8 A. If brushes are shifted backwards through 1.5 segments from the geometrical neutral axis, find the demagnetizing and distorting amp-turns/pole
7. A 500 kw, 500 V, 10 pole d.c. generator has a lap wound armature with 800 conductors. Calculate the number of pole face conductors in each pole of a compensating winding if the pole face covers 75 percent of pole pitch
8. Two shunt generators A and B operate in parallel and their load characteristics may be taken as straight lines. The voltage of A falls from 240 V at no-load to 220 V at 200 A, while that of B falls from 245 V at no-load to 220 V at 150 A. determine the current which each machine supplies to a common load of 300 A and the bus bar voltage at this load
9. In d.c. machine the total iron losses is 8 kw at its rated speed and excitation. If excitation remains the same, but speed is reduced by 25%, the total iron loss is found to be 5 kw. Calculate the hysteresis and eddy current losses at (i) full speed (ii) half the rated speed
10. Two generators each having no load voltage of 500 V, are connected in parallel to a constant resistance load consuming 400 kw. The terminal p.d. of one machine falls linearly to 470 V as the load is increased to 850 A while that of the falls linearly to 460 V when the load is 600 A. find the load current and voltage of each generator. If the induced e.m.f. of one machine is increased to share load equally find the new current and voltage

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PC 20EE305 Power Generation and Transmission 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO2	PO7	PO10	PSO1	
20EE305.1	Identify the different components of thermal, Hydro, and nuclear power plants	-	1	1	1	L1
20EE305.2	Explain different types of load curves and tariffs applicable to consumers	-	-	-	3	L1, L2
20EE305.3	Design the transmission line parameters for three phase, single and double circuit lines	3	3	2	1	L3
20EE305.4	Analyse the transmission lines and represent them by suitable equivalent circuits	2	1	1	1	L2,L3,L4
20EE305.5	Demonstrate sag/tension of transmission lines and performance of line	3	3	2	1	L1,L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Conventional Power Generating Systems 12 Hours

Thermal Power: Block Diagram of Thermal Power Station (TPS), Brief Description of TPS Components. Hydro Power: Selection of Site, Classification, Layout, Description of Main Components. Nuclear Power: Nuclear Fission and Chain Reaction-Principle of Operation of Nuclear Reactor - Description of Main Components.

Fundamentals of electromechanical energy conversion, Combined cycle power plants

Unit II: Economic Aspects of Power Generation & Tariff 12 Hours

Economic aspects - Load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, Base and peak load plants. Tariff methods - Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a Tariff method, Tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods.

Basic concepts of power and energy

Unit III: Transmission Line Parameters 12 Hours

Types of conductors, calculation of resistance for solid conductors, calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR & GMD, symmetrical and asymmetrical conductor configuration with and without transposition, calculation of capacitance for 2-wire and 3-wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical-single and three phase circuits-single and double circuit lines, numerical problems.

R, L, C parameters and their definitions, Ferranti, Skin and proximity effects

Unit IV: Modelling of Transmission Lines **12 Hours**

Classification of transmission lines, models and their representations, nominal-T, nominal- π and A, B, C, D constants, mathematical solutions to estimate regulation and efficiency of all types of lines, long transmission line-rigorous solution, evaluation of A, B, C, D constants, interpretation of the long line equations, surge impedance and surge impedance loading (SIL), wave length and velocity of propagation, skin effect, Ferranti effect, proximity effect charging current, numerical problems, applications.

Fundamentals of voltage regulation and efficiency, ABCD parameter calculations

Unit V: Sag and Tension Calculations and Overhead Line Insulators **12 Hours**

Sag and Tension calculations with equal and unequal heights of towers–Effect of wind and ice on weight of conductor–Numerical problems–Stringing chart and sag template and its applications–Types of insulators–String efficiency and methods for improvement–Numerical problems–Voltage distribution–Calculation of string efficiency–Capacitance grading and static shielding.

Properties of insulators, Grading of Insulators

Text Books

1. Soni M.L., Gupta P.V., Bhatnagar U.S. and Chakrabarti A, "A Text Book on Power System Engineering", 4th Edition, Dhanpat Rai & Co. Pvt. Ltd., 2016
2. Wadhawa C.L., "Generation, Distribution and Utilization of Electric Energy", 3rd Edition, New age International Pvt. Ltd.,2015
3. Nagarath I.J. and Kothari D.P., "Modern Power System Analysis", 2nd Edition, Tata McGraw Hill, , 2003

Reference Books

1. Kamaraju V, "Electrical Power Distribution Systems",8th Edition, Tata McGraw Hill, New Delhi, 2009
2. Deshpande M.V., "Elements of Electrical Power Station Design" 8th Edition, Prentice Hall India, New Delhi 2009
3. John J Grainger and William D Stevenson, "Power System Analysis", 4th Edition, Tata McGraw Hil, 2014
4. Gupta B.R., "Power System Analysis and Design", 4th Edition, Wheeler Publishing, 2005
5. Murthy P.S.R, "Electrical Power Systems", 3rd Edition, B. S. Publications, 2019

Web References

1. https://nptel.ac.in/courses/108/102/108102047/
2. https://www.digimat.in/nptel/courses/video/108102047/L01.html
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-toelectric-power-systems-spring-2011/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	30
L3	20	30
L4	-	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the meaning of travelling surges?
2. What is the importance of surge impedance?
3. What is the wavelength and velocity of propagation?
4. What is meant by Skin and Proximity effects?
5. What is meant by the Ferranti effect?

L2: Understand

1. Give the reasons why the lightning is a severe power system transient
2. Explain the concept of attenuation of travelling waves
3. Explain the various properties of corona and derive the expression for power loss due to corona
4. On which parameters the variation of conductor tension depends?
5. Explain string efficiency. Why is it necessary to have high string efficiency?

L3: Apply

1. A three phase, 220 kV, 50 Hz transmission line consists of a 1.2 cm radius of conductor spaced 2 m apart as an equilateral triangle configuration. Calculate disruptive critical voltage between the lines. Irregularity factor = 0.96, temperature= 25°, barometric pressure = 72.2 cm of Hg. Dielectric strength of air = 21.1 KV (rms)/cm. Also calculate corona power loss
2. A 3 phase 220 kV, 50 Hz transmission line consists of a 30 mm diameter conductor 2.51m apart in the form of an equilateral triangle. If the temperature is 38℃ and atmospheric pressure is 76 cm. Find the corona loss per km of the line? The irregularity factor is 0.83 and the stress is 21.21kV/cm
3. Calculate the inductance of a conductor per phase of a three phase, three-wire system. When the conductors are arranged at the corners of an equilateral triangle of 3.5 m sides and the diameter of each conductor is 2 cm
4. A single phase line has two pairs of conductors each pair comprises two 1.25 cm diameter conductors in parallel spaced vertically and 75 cm apart. But two parallel parts are spaced laterally by a distance of 1.5 m. Calculate the inductance of the line per km. Assuming current to be equal distributed
5. A single phase transmission line delivers 1 MVA at a power factor of 0.71 lagging, 22 kv, 50 Hz. The loop resistance is 15 ohms and inductance is 0.2H and capacitance is 0.5 microfarad. Find a) the voltage (b) the current (c) the power factor at sending end using nominal pi method

L4: Analyze

1. Calculate A, B, C, D constants for a 3-phase 50 Hz transmission line 200 km long having the following parameters l=1.2*10-3H/km c=8*10- 9F/km r=0.15Ω/km. Use nominal T-Method
2. Calculate A, B, C, D constants for a 3-phase 50 Hz transmission line 200 km long having the following distributed parameters l=1.2*10-3H/km c=8*10-9F/km r=0.15Ω/km g=0
3. Calculate A, B, C, D constants for a 3-phase 50 Hz transmission line 200 km long having the following parameters l=1.2*10-3H/km c=8*10- 9F/km r=0.15Ω/km. Use nominal PIE method
4. Calculate the inductance of each conductor of 3 phase 3 wire system when the conductors are arranged in a horizontal plane with spacing such that D31=4 m, D12=D23=2 m. The conductors are transposed and have a diameter of 3 cm
5. Compare the capacitance of a three-phase double circuit line with symmetrical spacing with the capacitance of a three-phase double circuit line with unsymmetrical spacing

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PC 20EC306 Electronic Devices and Circuits Lab 0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs
		PO4
20EC306.1	Identify and Demonstrate different semiconductor devices and measuring instruments.	3
20EC306.2	Experiment with the semiconductor devices and observe the characteristics.	3
20EC306.3	Design and analyse different types of rectifier circuits using PN Junction Diodes and interpret the results.	3
20EC306.4	Summarize the characteristics of BJT and FET.	3
20EC306.5	Design different amplifiers and evaluate their frequency responses.	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos		

List of Experiments

1. Identification, Specifications and Testing of active devices, passive devices (Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT).
2. Study the operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.
3. P-N Junction Diode V-I Characteristics (Forward bias & Reverse bias).
4. Zener Diode as voltage regulator.
5. Half-wave Rectifiers (without and with c-filter).
6. Full-wave Rectifiers (without and with c-filter).
7. BJT Input & Output Characteristics (CE Configuration & CB Configuration).
8. FET Drain & Transfer Characteristics (Common Source Configuration).
9. SCR Characteristics.
10. UJT Characteristics.
11. BJT CE Amplifier.
12. Emitter Follower - CC Amplifier.
13. FET Amplifier (Common Source Configuration).

References

1. Lab Manual for Electronic Devices and Circuits Lab of Electronics and Communication Engineering, NSRIT

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PC 20EE307 DC Machines & Transformers Lab 0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20EE307.1	Determine the Characteristic of DC motor and generator	3
20EE307.2	Estimate various losses in DC machines and transformers	3
20EE307.3	Differentiate between various control methods for DC motors	3
20EE307.4	Identify and compute safe operating limits for machines	3
20EE307.5	Obtain three phase to two phase transformation	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

1. Magnetization characteristics of DC shunt generator.
2. Brake test on DC shunt motor.
3. Speed control of DC shunt motor by Field and Armature Control.
4. OC & SC test on single phase transformer.
5. Sumpner's test on single phase transformer.
6. Parallel operation of Single-phase Transformers
7. Separation of core losses of a single-phase transformer
8. Hopkinson's test on DC shunt machines.
9. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
10. Separation of losses in DC shunt motor.
11. Scott connection of transformers
12. Load test on DC series generator
13. Load test on DC compound generator

References

1. Lab Manual for DC Machines & Transformers, Department of Electrical and Electronics Engineering, NSRIT
2. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', 6th Edition, Tata McGraw Hill Publishing company Ltd, 2008.
3. Gupta J.B.,, 'Theory and performance of Electrical Machines', 6th Edition, S.K.Kataria and sons, 2008

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PC 20EE308 Electrical Circuit Analysis Lab 0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs
		PO4
20EE308.1	Apply various theorems for simplifying both AC and DC circuits	3
20EE308.2	Assess the time response of series RL and RC circuits	3
20EE308.3	Determine the coefficient of coupling for given single-Phase transformer	3
20EE308.4	Evaluate various two port network parameters of an electric circuit	3
20EE308.5	Assess the Reactive and Active Power for the given star/delta connected loads.	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's		

List of Experiments

1. Verification of Thevenin's and Norton's Theorems.
2. Verification of superposition theorem and maximum power transfer theorem
3. Verification of compensation theorem
4. Verification of reciprocity, Millmann's Theorems
5. Determination of time constants of R-L, R-C, R-L-C networks.
6. Series and parallel resonance
7. Determination of self, mutual inductances and coefficient of coupling
8. Determine Z and Y Parameters
9. Determine the Transmission and hybrid parameters
10. Measurement of Reactive Power for Star and Delta connected Un-Balanced Loads.
11. Measurement of 3-phase Average power by two Wattmeter method for unbalanced loads

References

1. Lab Manual for Electrical Circuit Analysis Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Subhransu Sekhar Dash & VIjayakumar, "Electrical Engineering Practice Lab Manual", 1st Edition, Vijay Nicole Imprints Pvt. Ltd., 2013.
3. Jeyapovan.T, Saravanapandian.M and Pranitha.S, "Engineering Practices Lab Manual", 5th Edition, Vikas Publishing House Pvt. Ltd., 2009.

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SC 20EES01 MATLAB 1 0 2 2.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs
		PO5
20EES01.1	Learn the basic MATLAB commands	3
20EES01.2	Apply basic knowledge of on matrices, vectors	3
20EES01.3	Develop user- defined functions Loops ,Branches and other control Statements	3
20EES01.4	Solve mathematical problems using MATLAB programming	3
20EES01.5	Analyse electric networks using MATLAB	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's		

List of Experiments

Part-I: Introduction and theory

1. Introduction to MATLAB
2. MATLAB environment (command window, command history, workspace etc.)
3. Using the help system in MATLAB

Part-II: Practical experiments

4. MATLAB basics (operation, arrays, vectors, matrices)
5. Introduction to Linear algebra and different operations on vectors and matrices
6. Creation of M-files, scripts and user-defined functions
7. Plotting using MATLAB
8. Flow control and loops in MATLAB
9. Basic Math functions (trigonometry functions, complex numbers etc,)
10. Introduction to MATLAB Simulink.
11. Analyse performance of electric networks to determine parameters.
12. Application of network theorems using MATLAB/Simulink
13. Solving numerical methods using MATLAB programming.

Text Books

1. Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering",2nd Edition ,Pearson Education,2012
2. Steven C Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", 3rd edition, Mc Graw Hill,2016

Reference Books:

1. Andrew Knight, "Basics of MATLAB and Beyond", Chapman & Hall/CRC

2. Rudra Pratap, “Getting Started with MATLAB : A Quick Introduction for Engineers and Scientists”, 7th Edition ,Oxford University Press .

3. Stephen J Chapman, “MATLAB Programming for Engineers”, 6th Edition, Cengage India Learning Pvt. Ltd

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MC 20MCX02 Constitution of India 2 0 0 0.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20MCX02.1	Summerizing the basic features and modalities about Indian Constitution	3	3	1	L1
20MCX02.2	Identify the Indian Federalism and Panchayath Raj systems in Indian Constitution	3	3	1	L1
20MCX02.3	Identify the Legislature and Judiciary systems in Indian Constitution	3	3	1	L2
20MCX02.4	Interpreting the political system that exists in India	3	3	1	L1, L2
20MCX02.5	Categorising the contemporary issues in global politics and Election commission in India	3	3	1	L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge					

Unit I: Indian Constitution 10 Hours

Meaning of the Indian Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Indian Constitution and its Salient Features, The role of B. R. Ambedkar in the making of the Indian Constitution,The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional,The Historical Perspectives of the Constitutional Amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Local Self Government – Constitutional Scheme in India.

Unit II: Indian Federalism 10 Hours

Meaning and Definition of Federalism, Structure and Features of Indian Federalism, Difference between Indian and Federation of other States, Difference between Federal and Unitary Features, Critical Evaluation of the Indian Federal System, Decentralisation of Powers, Centre-State Relations, 73rd Amendment, Panchayath Raj Institutions.

Unit III: Union Government 10 Hours

Powers of Indian Parliament, Functions of Rajya Sabha and Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister. Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Lok Pal and Lok Ayukta, The Lokpal and Lokayuktas Act 2013.

Unit IV: Challenges to Indian Political System 10 Hours

Caste: A General Overview of the Indian Scenario,The Caste Issues in the Pre Independence Period, Gandhi Ambedkar Debate and the Poona Pact.The Politics of Caste in the Post Independence Period, Mandal Commission Reservation Policy in Government Jobs.The History of Communalism in India, The Concept of Terrorism and its Emergence in the Global Phenomenon since the End of Cold War.

Unit V: India's External Relations and Election Commission 10 Hours

Cold War and Post Cold War Era, Foreign Policy, Indian and its Neighbours, India's Extended Neighbourhood in West Asia and South East Asia. India's Relations with the United States and Russia, India and the World Organisations, India in the 21st Century. Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books

1. Austin G., "Working of a Democratic Constitution of India", Oxford University Press, New Delhi, 2004
2. Basu D. D., "An Introduction to the Constitution of India", Prentice Hall, New Delhi, 2005
3. Chandhoke N. and Priyadarshini, "Contemporary India: Economy, Society, Politics", Oxford University Press, New Delhi, 2009
4. Jayal N. G. and Maheta P. B., Oxford Companion to Indian Politics", Oxford University Press, New Delhi, 2010
5. Vanaik A. and Bharghava R. "Understanding Contemporary India: Critical Perspectives", Orient Blackswan, New Delhi, 2010

Reference Books

1. Noorani A. G., “Constitution Questions in India: The President, Parliament and the States”, Oxford University Press, New Delhi, 2000
2. Chakravarthy B. and Pandey K. P., “Indian Government and Politics”, Sage Publications, New Delhi, 2006
3. Bajpai. Kanti and Pant V. Harsh, “India’s Foreign Policy: A Reader”, Oxford University Press, New Delhi, 2013
4. Laxmikanth M., “Indian Polity for Civil Services Examinations”, Tata McGraw Hill, New Delhi, 2016
5. Singh M. P. and Saxena R., “Indian Politics: Contemporary Issues and Concerns”, PHI Learning, New Delhi, 2008

Web References

1. https://en.wikipedia.org/wiki/Federalism.in.India
2. https://legislative.gov.in/constitution-of-india
3. https://en.wikipedia.org/wiki/Foreign_relations_of_India
4. https://en.wikipedia.org/wiki/Government_of_India

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HS 20HSX03Managerial Economics and Financial Analysis 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20HSX03.1	Understand the theoretical concepts of managerial economics to make decisions for business problems	3	1	L1,L2
20HSX03.2	Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations	3	1	L1,L2
20HSX03.3	Understand the basic accounting principles to prepare final Accounts	3	1	L1,L2
20HSX03.4	Apply Financial planning techniques to make successful longterm investment decisions.	3	1	L3,L4
20HSX03.5	Apply accounting concepts to analyze financial strength of business	3	1	L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UnitI: Introduction to Managerial Economics and Demand Analysis9 Hours

Definition of Managerial Economics –Scope of Managerial Economics and its Relationship with other Subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand Schedule, Demand Curve, Law of Demand and its Limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand Forecasting and Methods of Forecasting.

Role of Managerial Economist, Law of Supply

Unit II: Production and Cost Analysis 9 Hours

Theory of Production: Meaning and Factors of Production, Production Function with One Variable Input (Law of Variable Proportion), With Two Variable Inputs (Law of Returns to Scale) Theory of Cost: Different Cost Concepts and Different Relations between Cost and Output in Short Run and Long Run. Managerial uses of Revenue and Cost Concepts Break-Even Point). Pricing Strategies.

Economies of Scale and Diseconomies of Scale

Unit III: Introduction to Final Accounts 9Hours

Financial Accounting- Concepts and Conventions – Double Entry System – Preparation of Journal, Ledger and Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet.
Branches of Accounting

Unit IV: Introduction to CapitalPlanning 9 Hours

Cocept of Capital – Types of Capital - Capital Budgeting -: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time Value of Money- Methods of Appraising Project Profitability - Traditional Methods and Modern Methods.

Concept of Working Capital

Unit V: Financial Analysis through ratios 9 Hours

Computation, Analysis and Interpretation of Liquidity Ratios (CurrentRatio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital StructureRatios (Debt - Equity Ratio, Interest Coverage Ratio) and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio,Operating Ratio, P/E Ratio and EPS).

Cash Flow Statement and Funds Flow Statement (Theory Only)

Text Books

1. AppaRao N., Vijay Kumar P., “Managerial Economics and Financial Analysis”, Cengage Publications, New Delhi, 2011
2. Siddiqui S. A. and Siddiqui A. S., “Managerial Economics and Financial Analysis”, New Age International Publishers, 2012
3. Kuberudu B. and Ramana T. V., “Managerial Economics and Financial Analysis”, Himalaya Publishing House, 2014
4. Aryasri A. R., “Managerial Economics and Financial Analysis”, Tata Mcgraw Hill, 2011

Reference Books

1. Maheswari V., "Managerial Economics", Sultan Chand,2014
2. Suma Damodaran, " Managerial Economics", Oxford, 2011
3. Vanitha Agarwal, " Managerial Economics", Pearson Publications, 2011
4. Sanjay Dhameja, "Financial Accounting for Managers", Pearson Publications, 2011
5. Maheswari V., "Financial Accounting", Vikas Publications, 2012
6. Dominick Salvatore,"Managerial Economics: Principles and World Wide Application", 7th Edition, Oxford University Press, 2012

Web References

1. https://btechgeeks.com/mefa-notes/#google_vignette
2. https://www.smartzworld.com/notes/managerial-economics-and-financial-analysis-pdf-notes-mefa
3. https://www.scribd.com/document/259129127/Mefa-course-plan
4. https://www.coursera.org/browse/business/entrepreneurship

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	20	20
L3	20	20
L4	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Managerial Economics?
2. What is meant by Elasticity of demand? How do you measure it?
3. Define different product curves
4. Define Accounting
5. Define Partnership

L2: Understand

1. Explain the role of a Managerial Economist in a Business firm
2. Explain the concept cross elasticity of demand. Illustrate your answer with suitable examples
3. Explain the formation of a Joint Stock Company
4. Distinguish between a partnership and a joint stock company
5. Explain accounting principles

L3: Apply

1. Journalise the following transactions
   2013 Jan 1st ABC Firm commenced business with Rs.40000
   Jan 2nd Deposited into bank Rs.30000
   Jan 3rd Bought goods worth Rs.48000 from Kamala
   Jan 4th Sold goods worth Rs.60000
2. Calculate Net Profit Ration from the following data
   Sales returns Rs.100000 Administration expences Rs.10000
   Gross Profit Rs.40000 Selling expences Rs.10000
   Income from investment Rs.5000 Loss on account of fire Rs.3000
3. From the following particulars findout
   Selling price Rs.200 per unit
   Variable cost Rs.100 per unit
   Total fixed cost Rs.96000
   i) Break even units and values
   ii) Sales to earn a profit Rs.20000

4. The following are the Ratios related to XYZ Limited company.
   Inventory holding period 2 months
   Gross profit ration 25 %
   Gross profit for the current year announced Rs.200000
   Closing stock is excess of Rs 40000 over opening stock. Findout
   A) Sales
   B) Cost of goods sold
   C) Closing stock
   D) Opening stock

L4: Analyze

1. A Project cost is Rs.144000. The average annual cash inflows are likely to be Rs.45000 for a period of 5 Years calucalte IRR for the project
2. The cost of project is Rs.50000 The annual cash iunflows for the next 4 years are Rs.25000 what is the PBP for the project
3. A firm is considering two different investment options A & B detailes of both the options are given below (Rs,in Lakhs)

	Investment cost	**Inflow 1**	**Inflow 2**	**Inflow 3**
Option A	(25)	10	10	12
Option B	(40)	15	20	24

4. ARR method (ARR on original investment)
   Inintial investment Rs.1200000

Year	Cashinflows (Rs)	
	Project A	Project B
1	600000	500000
2	500000	300000
3	200000	200000
4	-	300000

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BS 20BSX15 Probability and Statistics 3 1 0 3.0

At the end of the course, students will be able to

	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX15.1	Classify the concepts of Statistics and its importance and Interpret Measures of Central Tendency and Dispersion of Data	3	1	L1, L2, L3
20BSX15.2	Identify the suitable discrete and continuous probability distributions to solve various engineering problems	3	1	L1, L2, L3
20BSX15.3	Identify the estimation errors in sampling distributions	3	1	L1, L2, L3
20BSX15.4	Apply the proper test statistics to test the hypothetical data by Tests of Hypothesis	3	1	L1, L2, L3
20BSX15.5	Apply the method of least squares, correlation and regression analysis to fit the curves	3	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Descriptive statistics methods. **11+1 Hours**

Introduction to Statistics- Population vs Sample -Collection of data primary and secondary data- Data visualization, Measures of Central tendency, Measures of Variability (spread or variance)- Skewness-Kurtosis.

Measures of Dispersion – Range – Quartile Deviation

Unit II: Probability and Probability Distributions. **11+1 Hours**

Review of probability- Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

Moment generating function

Unit III: Sampling Theory. **11+1 Hours**

Introduction – Population and samples – Sampling distribution of Means and variances(Definitions only) – Central limit theorem (without proof) -Introduction to Student's t- Distribution, Chi-square Distribution and F- Distribution Point and Interval Estimations Maximum error of estimate.

Introduction to Sampling, parameters, statistics.

Unit IV: Tests of Hypothesis. **11+1 Hours**

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means - Small samples:
Student t-distribution (test for single mean, two means and paired t-test) - Chi-square test for Single variance- Chi-square - Test for goodness of fit

Test for single proportion, difference of proportions (large samples)

Unit V: Curve fitting, Correlation and Regression **11+1 Hours**

Curve fitting: Method of least squares – Straight line – Parabola – Exponential – Power curves.
Correlation: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines.

Power curves by the method of least squares

Textbooks:

1. Miller and Freund J. E, "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011.
2. Iyenger.T.K.V, Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Probability & Statistics", 2nd Edition, S. Chand publications, 2019.

Reference Books:

1. Arnold O. Allen, "Probability & Statistics", Academic Press, 2nd Edition, 2005.
2. Shahnaz Bathul, "A text book of Probability & Statistics", 2nd Edition, V. G. S. Book Links, 2nd Edition, 2007.
3. Murugesan and Gurusamy, "A text book of Probability & Statistics", 2nd Edition Anuradha Publications, 2011.

Web References:

1. https://nptel.ac.in/courses/111106112/
2. https://nptel.ac.in/courses/111105090/
3. https://nptel.ac.in/courses/111101004/
4. https://nptel.ac.in/courses/111102111/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

L1: Remember

1. Define conditional probability
2. Define Population and Sample
3. Write about Skewness and Kurtosis.
4. State Correlation and Regression
5. State Mean and Variance in Sampling Distribution

L2: Understand

1. State and prove Bayes theorem.
2. Write the differences of collection of primary and secondary data type of variable.
3. Find out the Kurtosis of the data

Class Interval	0 -10	10 - 20	20 – 30	30 - 40
Frequency	1	3	4	2

4. The mean height of students in a college is 155cms and S.D. is 15. What is the probability that mean height of 36 students is less than 157 cms
5. The number of auto mobile accidents per week in a certain community are as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accident conditions were the same during this 10 weeks period

L3: Apply

1. Calculate the regression equation Yon X from the data given below taking deviations from the actual means of X and Y

Price(Rs)	10	12	13	12	16	15
Amount Demanded	40	38	43	45	37	43

2. The coefficient of Rank Correlation between marks in Statistics and Mathematics obtained by a certain group of students is 0.8. If the sum of the squares of the difference in ranks to be 33. Find the number of students in the group
3. A normal population has a mean of 0.1 and S.D. of 2.1 then find the probability that mean of a sample of size 900 will be negative.

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Board of Studies (EEE)

PC 20EE403 Control Systems 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO3	PSO 1	
20EE403.1	Find the transfer function of physical systems using block diagram algebra and signal flow graphs.	-	3	L1,L2,L3
20EE403.2	Examine the time responses of various systems for various input standard signals.	-	3	L1,L2,L3,L4
20EE403.3	Demonstrate the stability of a system using Time Domain Techniques.	2	1	L1,L2,L3,L4
20EE403.4	Illustrate the Stability of a system using Frequency Domain Techniques.	3	1	L1,L2,L3,L4
20EE403.5	Apply the state space modelling for solving problems related to real world Physical Systems	3	3	L1,L2,L3,L4
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge				

Unit I: Mathematical Modeling of Control Systems **12 Hours**

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations ofelectrical networks, translational and rotational mechanical systems, transfer of DC servo motor - AC servo motor - synchro, transmitter and receiver - block diagram algebra - representation by signal flow graph – Reduction using Mason's Gain formula

Effect of feedback on disturbance and Noise

Unit II: Time Response Analysis **12 Hours**

Standard test signals - time response of first and second order systems - step response of 2nd order system - time domain specifications, steady state errors and error (static and dynamic) constants, P, PI, and PID controllers.

Ramp response of 2nd order system

Unit III: Stability and Root Locus Technique **12 Hours**

The concept of stability – characteristic equation - location of roots in s-plane for stability - Routh's Stability Criterion – limitations of Routh's stability, Root locus concept - construction of root loci, Effect of addition of poles and zeros root locus

Effect of addition of poles and zeroes on root locus

Unit IV: Frequency Response Analysis **12 Hours**

Introduction to frequency domain specifications - Bode diagrams - transfer function from the Bode diagram - phase margin and gain margin stability analysis from Bode plots Polar plots, Nyquist stability criterion.
Lag, lead, lag-lead compensators, design of compensators using Bode plots.

M & N circles, Nicholas Charts

Unit V: State Space Analysis of LTI Systems: **12 Hours**

Concepts of state, state variables and state model, state space representation of transfer function, derivation of state models from block diagrams, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Eigen Vectors and Diagonalization

Textbooks:

1. Nagarath I.J. and .Gopal M, "Control Systems Engineering", 2nd Edition, New age InternationalPublications, ,2018.
2. Benjamin C.Kuo, "Automatic control systems", 8th Edition, John Wiley and sons, , 2014.

Reference Books:

1. Norman S Nise, "Control Systems Engineering", 3rd Edition, John Wiley and sons, 2018.
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd, , 2015.
3. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.
4. Alice Mary K and Ramana P, "Control Systems", 1st Edition, Universities Press, 2016.

Web References:

1. https://nptel.ac.in/courses/107/106/107106081/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	10
L2	30	30
L3	40	30
L4	-	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the various standard test signals?
2. Define electrical zero position of synchro transmitter
3. Define concept of observability
4. What is compensation? What are the different types of compensators?
5. What is state transition matrix? Write its properties

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Compare different characteristics of A.C servo motor and D.C servo motor
3. Explain procedure of Bode plot and determination of gain margin and phase margin from Bode plot
4. Procedure for design of lead compensator using Bode plot
5. Explain about feedback characteristics?

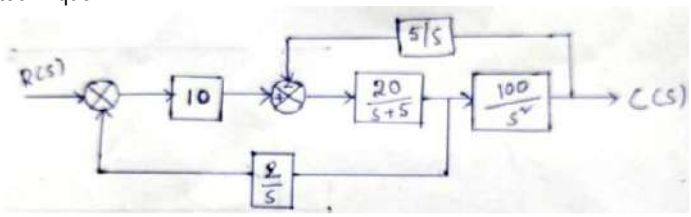
L3: Apply

1. The characteristic polynomial of a system is.$s^5+2s^6+3s^5+s^4+5s^3+2s^2+s+7=0$. Determine the location of roots on the S-plane and hence the stability of the system
2. Construct Nyquist plot for a feedback control system whose open loop transfer function is given by G(s) H(s) = s/s(s-1), comment on stability of open loop and closed loop system
3. Determine range of K for stability of unit feedback system whose open loop transfer function is G(s) = K/s(s+1)(s+2)
4. Calculate the angle of asymptotes and the centroid for the system having G(s) H(s) = K(s+3)/s(s+4)(s+2)(s+5)
5. For a system having G(s) = 25/s(s+10) and units negative feedback, find its time response specifications

L4: Analyze

1. State the necessary and sufficient conditions for stability for first and second order control systems. Explain why these conditions are necessary but not sufficient for stability of higher order systems
2. Differentiate the advantage and disadvantages of root locus and Bode Plot

3. Justify whether the stat space model is controllable are not
4. Outline the state space model in different canonical forms
5. For the block diagram of the system shown, determine the transfer function using the block diagram reduction technique



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Board of Studies (**EEE**)

PC 20EE404 Induction Motors and Synchronous Machines 3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's			DoK
		PO2	PO3	PSO 1	
20EE404.1	Demonstrate performance of three phase induction motors and their characteristics	-	-	3	L1,L2,L3
20EE404.2	List the different techniques related to speed control and starting of 3-phase induction motor.	-	-	3	L1,L2
20EE404.3	Discuss the operation and design different types of single phase induction motor	-	3	1	L1,L2
20EE404.4	List the different types of alternators and design alternators based on their performance characteristics	1	3	1	L1,L2,L3
20EE404.5	Interpret the performance of synchronous motors based on their applications	1	-	2	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Three Phase Induction Machines. **11+1 Hour**

Constructional features, salient pole, non-salient pole, Rotating magnetic field, Principle of operation, Torque and power equations, Torque- slip characteristics, Equivalent circuit, Power flow analysis, losses in the machine – No load and blocked rotor tests Circle diagram, Cogging phenomenon and remedies, Crawling phenomenon and remedies

Production of RMF

Unit II: Starting methods & Speed control of Three Phase Induction Machines **11+1 Hour**

Problems in starting of induction motor, Starting of squirrel cage induction motors-I, Starting of squirrel cage induction motors-II, Starting of wound rotor/slip ring induction motors, Speed control of induction motor from stator end – through stator voltage - Pole changer - Frequency control - Speed control of induction motor from rotor end – through rotor resistance control and Cascade connection, Slip power recovery scheme

Losses of three phase induction motor

Unit III: Single Phase Induction Machine **11+1 Hour**

Construction of single phase induction motor, Working – Double revolving field theory, Torque-slip characteristics , equivalent circuit, Power flow analysis, No load and blocked rotor tests, determination of equivalent circuit parameters, Split phase motors – Resistance start motors, Capacitor start motors, Capacitor start and capacitor run motors, Permanent split capacitor / single value capacitor motors, Shaded pole motors

BLDC motor and Universal motor

Unit IV: Synchronous Machine I **11+1 Hour**

Constructional features of 3 phase alternators, Armature winding, EMF Equation, Winding Coefficients, Equivalent circuit and phasor diagram, Armature reaction. O. C. & S. C. tests, Voltage regulation using Synchronous Impedance method, MMF method, Potier's Triangle method, Parallel operation of synchronous generators, Two reaction theory, Applications

Synchronizing power and torque, applications of synchronous generator

Unit V: Synchronous Machine II **11+1 Hour**

Construction of Synchronous motor, Principle of operation , Starting methods, Effect of varying field current at different loads, V and Λ curves, Synchronous condenser, Applications.

Excitation circle and power circle, comparison of synchronous and induction motors

Textbooks

1. Bhimbra P. S., "Electrical Machinery", 7th edition, Khanna Publishers, colour reprint 2014
2. Nagarth I. J. & Kothari D. P, "Electrical Machines", 5th edition, Tata McGraw Hill Publications, 2017

Reference Books

1. Kothari D. P., Nagarth I .J ., “Electrical Machines”, 4th edition McGraw Hill Publications, 2017
2. Rajput R.K., “Electrical Machines”, 5th Edition, Lakshmi publications, 2016
3. Abijith Chakrabarthi and Sudhipta Debnath,” Electrical Machinery”, 2nd Edition, McGraw Hill education, 2015
4. Stephen J Chapman “Electrical Machinery Fundamentals”, 1st Edition, McGraw Hill education, 2010

Web References

1. https://nptel.ac.in/courses/108/104/108104087/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State the principle of three phase induction motor
2. Mention the types of speed control methods of three phase induction motor
3. State why the single phase induction motor is not self-starting
4. State the need of parallel operation of synchronous generators
5. Define synchronous condenser

L2: Understand

1. Explain the construction of three phase induction motor
2. Describe the operation of single phase induction motor
3. Explain about double cage rotor in three phase induction motor
4. Explain the starting methods of synchronous motor

L3: Apply

1. Construct the circle diagram of three phase induction motor
2. Calculate equivalent circuit parameters of single phase induction motors
3. Derive the EMF equation for three phase alternators

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ES 20EE405 Electro Magnetic Field Theory 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's		DoK
		PO3	PSO 1	
20EE405.1	Define electrostatic laws and apply them to electrostatic fields	2	1	L1, L2
20EE405.2	Demonstrate the properties of conductors and dielectrics at different configurations	2	1	L1, L2
20EE405.3	Define Biot-Savart's law and Ampere circuit law and apply them to magnetic field	2	1	L1, L2
20EE405.4	Explain the magnetic force experienced by charged particles and determine types of inductances	2	1	L1, L2
20EE405.5	Describe time varying fields using Faraday's law and Maxwell's equations	2	1	L1
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge				

Unit I: Introduction Of Fields and Electrostatics **12 Hours**

Scalar and vector fields, overview of coordinate system, calculus of scalar and vector fields in Cartesian coordinates; Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge, work done in moving a point charge in an electrostatic field, Electric flux density, electric potential – properties of potential function – potential gradient, Maxwell's first and second equation, Gauss's law –Laplace's and Poison's equations.

Relation between cylindrical and cartersian co-ordinates

Unit II: Conductors – Dielectrics and Capacitance **12 Hours**

Electric dipole – dipole moment – potential and EFI due to an electric dipole, Behavior of conductors in an electric field-Conductor- Dielectric and Dielectric – Dielectric Boundary Conditions, Polarization, Capacitance of parallel plates, spherical and coaxial cable, energy stored and energy density in a static electric field, Ohm's law in point form, equation of continuity, properties of materials in electric field.

Conduction and convention current density, Di-electric constants

Unit III: Magneto Statics **12 Hours**

Biot-Savart's law, Oesterd's Experiment, Magnetic Field Intensity (MFI) – MFI due to a straight current carrying filament, MFI due to circular, square and solenoid; relation between magnetic flux, magnetic flux density and MFI, Ampere's circuital law, point form of Ampere's circuital law – applications, Maxwells Third Equation MFI due to an infinite sheet of current and a long filament carrying conductor, Point form of Ampere's Circuital Law – Maxwell's Equation Curl(H) = J.

Magnetic Field Inntensity at middle of equilateral triangle

Unit IV: Magnetic Force and Inductance **12 Hours**

Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment, Torque on a current loop placed in a magnetic field, properties of materials in magnetic field

Scalar and Vector magnetic potential – properties and limitations; Self and Mutual Inductances – Mutual inductance between a straight long wire and square loop wire in the same plane; energy stored and density in a magnetic field.

Self inductance of toroid, Co-axial cable

Unit V: Time varying Fields **12 Hours**

Time varying fields: Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation, Curl (E)=-∂B/∂t, statically and dynamically induced EMF.

Modified maxwell equation

Text Books

1. Sadiku, "Principles of Electro Magnetics", 4th Edition, Oxford Publications, 2016
2. William H. Hayt and John. A. Buck, "Engineering Electromagnetics", 9th Edition, McGraw Hill Companies, 2020
3. S.Salivahanan and S.Karthie., "Electromagnetic Fields and Waves", 2nd Edition, McGraw Hill Companies, 2018

Reference Books

1. Griffiths D. J., "Introduction to Electro Dynamics", 4th Edition, Prentice Hall of India Pvt. Ltd., 2020
2. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, Oxford Higher Education, 2012

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Divergence, Gradient and Curl
2. Define dot and cross product
3. What is vector field and vector potential?
4. State gauss law
5. Define Laplace equation

L2: Understand

1. Derive the expression for electric field intensity due to infinite surface charge
2. Explain the behaviour of conductors in electric field
3. Determine self and mutual inductance
4. Given V = 5x3y2z and e = 2.25e_0, find (i) **E** at point P(-3, 1, 2) (ii) ρ_v at P
5. Illustrate a expression for capacitance of a parallel plate capacitor

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PC 20EE406 Induction Motors & Synchronous Machines Lab 0 0 3 1.5

At the end of the course, students will be able

Code	Course Outcomes	Mapping with POs
		PO4
20EE406.1	To understand the performance of single phase and three phase induction motors	3
20EE406.2	To control the speed of three phase induction motors	3
20EE406.3	To analyse the characteristics of V and inverted V curves of synchronous motors	3
20EE406.4	To determine the efficiency of three phase alternator	3
20EE406.5	To determine the regulation of alternator by various methods	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's		

List of Experiments

1. Brake test on three phase induction motor
2. No-Load and Blocked rotor test of three phase induction motor
3. Power factor improvement of single-phase induction motor by using capacitors and load test on single phase induction motor
4. Equivalent circuit of single-phase induction motor
5. Speed control of induction motor by V/F method
6. Brake test on single phase induction motor
7. V and inverted V curves of three phase synchronous motor
8. Determination of Xd and Xq of salient pole synchronous machine
9. Regulation of three phase alternator by synchronous impedance and MMF method
10. Regulation of three phase alternator by Potier trangle method
11. Parallel operation of three phase alternator
12. Determination of efficiency of three phase alternator by loading with three phase induction motor

References

1. Lab Manual for "Induction Motors and Synchronous Machines Lab", Department of Electrical and Electronics Engineering, NSRIT
2. Bimbhra P.S.,, "Electrical Machines" 7th Edition, Khanna publishers, 2006

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PC 20EE407 Industrial Automation for Electrical & Electronics Engg 0 0 3 1.5

Code	Course Outcomes	Mapping with POs
		PO4
20EE408.1	Draw the ladder logic diagram for Boolean logic and monitor with SCADA	3
20EE408.2	Draw the ladder logic and ladder latching logic diagrams for timers, counters, combinations and monitor with SCADA	3
20EE408.3	Draw the ladder latching logic diagram for counters and timers	3
20EE408.4	Develop ladder logic for traffic signal Control and flash a light once in every one second and monitor with SCADA	3
20EE408.5	Development of ladder logic for various practical applications	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's		

List of experiments

1. Switch on light/off light for logic gates *AND, NOR, NAND, NOR, NOT, XOR, HALF, ADDER, FULL ADDER) by using Ladder Logic and SCADA monitoring
2. Develop the ladder logic for the below Boolean logic function before and after simplification

$$Y = \overline{(AB\bar{C}D + AB\bar{C}\bar{D} + \bar{A}BCD + \bar{A}\bar{B}CD)} + D$$

3. Switch on light/off light with timers (on Delay and Off Delay), counters (up & down) and their combination by using Ladder logic and SCADA monitoring.
4. Switch on light/off with timers and switch on light/off light with counter by using Ladder latching logic and SCADA monitoring.
5. Write small ladder logic programs for traffic signal control and controlled by SCADA.
6. Develop a ladder logic program that will flash a light once every one second and controlled by SCADA
7. Develop a ladder logic for the motor which is controlled by two switches. The start switch will start the motor and the Stop switch will stop it. If the Stop switch was used to stop the motor, the start switch must be thrown twice to start the motor (The Stop switch will be wired as normally closed). And monitoring by SCADA.
8. Develop a ladder logic for the motor which is controlled by two switches. The start switch will start the motor after 10 seconds delay and the Stop switch will stop the motor after 10s delay. If the Stop switch was used to stop the motor, the start switch must be thrown twice to start the motor. When the motor is active a light should be turned on. And monitoring by SCADA
9. Develop a ladder logic for oven started with a Start button that seals in the Auto mode. This can be stopped if the Stop button is pushed. (Remember: Stop buttons are normally closed.) When the Auto goes on initially the TON timer is used to sound the horn for the first 5 seconds to warn that the oven will start, and after that the horn stops and the heating coils start. When the oven is turned off the fan continues to blow for 300s or 10 sec after. And monitoring by SCADA
10. Develop ladder logic for conveyor run by switching on or off a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active. And monitoring by SCADA
11. To study the variable frequency drive based 3phase induction motor operation by key pad

References

1. Lab Manual for Industrial Automation for Electrical & Electronics Engg Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Frankpetruzella D , " programmable logic controllers", 3rd Edition Tata MC Graw Hill, 2010

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PC 20EE408 Control Systems Lab 0 0 3 1.5

Code	Course Outcomes	Mapping with POs	
		PO4	PSO1
20EE408.1	Analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors and synchronous motors.	3	3
20EE408.2	Design P,PI,PD and PID controller, design lag, lead and lag–lead compensators	3	3
20EE408.3	Determine the transfer function of D.C.motor	3	3
20EE408.4	Control the temperature using PID controller	3	3
20EE408.5	Control the position of D.C servo motor performance	3	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's			

List of experiments

1. Time response of Second order system
2. Characteristics of Synchro
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor using MATLAB
6. Characteristics of magnetic amplifier
7. Characteristics of AC servo motor
8. Characteristics of AC servo motor
9. Root locus and Bode plot from MATLAB
10. DC position control system
11. Controllability and observability test using MATLAB
12. Temperature controller using PID

References

1. Lab Manual for Control Systems Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Nagarath I.J. and Gopal M, "Control Systems Engineering", 2nd Edition New age International Publications, , 2018
3. Norman S Nise, "Control Systems Engineering", 3rd Edition John Wiley and sons, , 2018

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SC 20EES02 PLC 1 0 2 2.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO3	PO4
20EES01.1	Determine Automation & System Overview, Engineering Software TIA Portal	3	3
20EES01.2	Distinguish b/w logic Gates, Circuit diagrams, Timers, Counters, FC's, OB's, DB's and PLC Tags	3	3
20EES01.3	Write Ladder program for various applications	3	3
20EES01.4	Communicate between PLC's	3	3
20EES01.5	Understand Control Strategies	3	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's			

List of Experiments

MODULE 1: Automation Overview, System Overview.

MODULE 2: Digital Fundamentals, Engineering Software TIA Portal, STEP 7 Range of Products

MODULE 3: Devices & Networks, PLC Tags, Program Blocks and Program Editor.

MODULE 4: Binary Operations, Digital Operations, Data Blocks.

MODULE 5: Functions and Function Blocks, Organization Blocks, Troubleshooting

Text Books

1. Madhuchhanda Mitra, Samarjt Sengupta, "Programmable Logic Controllers and Industrial Automation: An Introduction", 2nd Edition, Penram International Publishing (India) Pvt.Ltd., 2017
2. Hackworth, "Programmable Logic Controllers Programming Methods And Applications", 1st Edition, PEARSON INDIA, 2011

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