Purbanchal University

Faculty of Engineering

Biratnagar, Nepal

Fourth Semester's Course Structure

Program: Bachelor in Electrical Engineering

Effective from 2021 (2078) Batch

Year-II **Semester-III**

S.N.	Course code	Subject	Credit Hours	L	T	P	Total	Internal		Final		Total
								Th.	P	Th.	P	
1		Applied Mathematics	3	3	3	-	6	40		60	-	100
2		Electromagnetics	3	3	1	3/2	5.5	40	25	-	-	125
3		Numerical Methods	3	3	1	3	7	40	25	60	-	125
4		Electrical Machine	3	3	1	3/2	5.5	40	10	60	15	125
5		Power System Analysis-I	3	3	1	3/2	5.5	40	10	60	15	125
6		Instrumentation	3	3	1	3/2	5.5	40	10	60	15	125
		Total	18	18	8	9	35					725

Note- **L:** Lecture **T:** Tutorial **P :** Practical **Th. :** Theory

Purbanchal University

Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Biomedical/Electrical/Electronics Communication & Automation Engineering
Subject: Applied Mathematics

Year-II **Semester-**IV

Teaching Schedule Hours/Week					Examination Schedule						Total Marks
					Final				Internal Assessment		
					Theory		Practical		Theory Marks	Practical Marks	
Credit Hours	L	T	P	Total	Duration	Marks	Duration	Marks	40	-	100
3	3	3	-	6	3 Hrs.	60	-	-			

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

OBJECTIVES: The main aim of this course is to provide students a sound knowledge of complex functions and their integration, Z transform and application, Fourier integral and transform partial differential equations.

1. Complex Variables 15 Hrs

1.1 Function of complex variables

1.2 Introduction: limit, continuity, differentiability, Laplace equation, harmonic function

1.3 Analyticity of function, Cauchy-Riemann equations (without derivation) in Cartesian and polar form

1.4 Taylor series, Laurent series of complex valued function

1.5 Singularities, zeros and poles of complex valued function

1.6 Complex integration, Cauchy integral formula

1.7 Residues, Cauchy Residue theorem with proof, complex integration by residue methods.

2. Z-Transform 10 Hrs

2.1 Introduction, One sided and two sided Z-transforms

2.2 Unit step function, Ramp function, Polynomial function, Exponential function, Unit impulse function, Linear time invariant system, response to the unit spike and their Z transform

2.3 Properties of Z-transform, Region of convergence, relation to casualty
2.4 Inverse Z – Transform, Convolution theorem, Parseval's Theroem
2.5 Difference equation and its solution, representation of system transfer functions in Z domain

3. Fourier Integral and Transform **7 Hrs**

3.1 Review of Fourier series, Fourier Series in Complex Form
3.2 The Fourier integral and its inversion
3.3 Fourier sine and cosine transform and their inversion
3.4 Forward and inverse Fourier transform
3.5 Magnitude, energy and phase equation

4. Partial Differential Equation **13 Hrs**

4.1 Introduction
4.2 One Dimensional wave equation and its solution
4.3 Diffusion equation (One and two dimensional heat equation) and then solution
4.4 Laplace equation in two dimensions and its solution
4.5 Polarform of Laplace equation and its solution

<u>Text Book</u>

1. Zill D., Wright W. S. and M. R. Cullen, *Advanced Engineering Mathematics*, Jones and Bartlett Publishers Inc.
2. Kreyszig, E. (1999), *Advanced Engineering Mathematics, 9th Edition*, John Wiley and Sons.
3. Peter V. O'Neil , *Advanced Engineering Mathematicss* , 8 th Edition , University of Alabama at Birmingham

Question specification:

Long Questions:[6*10 = 60 marks]

Unit 1: (4 questions with 1 OR question)
1.2/ 1.3, 1.4/1.5, 1.6/1.7
Unit 2 : (2 questions with 1 OR question)
2.3 / 2.4, 2.5
Unit 3: (2 questions with 1 OR question)
3.2, 3.3 / 3.4
Unit 4: (2 questions with 1 OR question)
4.2, 4.3, 4.4/ 4.5

PURBANCHAL UNIVERSITY

Model Question 2023

Progran: BE Biomedical/Electrical/ Electronics, Communication & Automation
Semester: IV
Subject : Applied Mathematics — Full marks – 60
Time : 3:00 hrs — Pass marks – 24

Answer all the questions. (10X6 = 60)

1. If a function f(z) = u(x,y)+ iv(x,y) is differential at any print z= x+iy and satisfies the first order partial derivatives u_x, u_y, vx_x,v_y then show that $u_x = v_y$, $u_y = -v_x$
2. If u = sinxcoshy then show that u is harmonic and find the analytic function.
3. Evaluate $\int_c \frac{3z^2+7z+1}{z+1}dz$ where c is the circle $|z|=1/2$ by Cauchy's integral formulae.

   Or

   Obtain the Taylor's and Laurent's series of the function $f(z) = \frac{1}{(1+z^2)(z+2)}$ when $1<|z|<2$
4. Evaluate $\int_c \frac{z-1}{(z+1)^2(z-2)}$ by residue theorem about the paths c with |z-i| = 2
5. (a) Find the z-transform of $f(t) = (1-at)e^{-at}$.

   (a) Find the value of $x(z) = \frac{2z^2+3z+12}{(z-1)^4}$
6. Find the inverse z-transform of $x(z)= \frac{z^2}{(z-1)^2(z-e^{-at})}$

   Or

   Solve the difference equation x(k+2) – 2x(k+1) +x(k) = 3k+5
7. Find the Fourier cosine integral of $f(x) = e^{-kx}$, x>0, k>0

   Or

   Find the Fourier sine integral of f(x)= sinx , for $0<x<\pi$
   = 0 for $x>\pi$
8. Find the Fourier Transform of $f(x) = 1- x^2$ for $|x| < 1$
   = 0 for $|x|>1$

   And hence evaluate $\int_0^\infty \frac{x\cos x-\sin x}{x^3}\cos\frac{x}{2}\,dx$.
9. Solve the wave equation $\frac{\partial^2 u}{\partial t^2} = c^2\frac{\partial^2 u}{\partial x^2}$ under the condition u(0, t) = 0, u(π,t)= 0 , $(\frac{\partial u}{\partial t})_{t=0} = u_t(x,0) = 0$

10. Solve $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$ given that

(i) U = 0 when x -= 0 and x=l for all t

(ii) $U = 3\sin\frac{\pi x}{l}$ when t = 0 for all $0<x<l$

Or

Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for $0<x<\pi$, $0<y<\pi$ with the condition $u(0, y) = u(\pi,y) = 0$, $u(x,\pi) = \sin^2 x$.

Purbanchal University
Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Electrical Engineering
Subject: Electromagnetics

Year-II   **Semester-**IV

<table>
<tr><th colspan="5" rowspan="3">Teaching Schedule Hours/Week</th><th colspan="6">Examination Schedule</th><th rowspan="3">Total Marks</th></tr>
<tr><th colspan="4">Final</th><th colspan="2">Internal Assessment</th></tr>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th><th>Theory Marks</th><th>Practical Marks</th></tr>
<tr><th>Credit Hours</th><th>L</th><th>T</th><th>P</th><th>Total</th><th>Duration</th><th>Marks</th><th>Duration</th><th>Marks</th><td rowspan="2">40</td><td rowspan="2">25</td><td rowspan="2">125</td></tr>
<tr><td>3</td><td>3</td><td>1</td><td>3/2</td><td>5.5</td><td>3 Hrs.</td><td>60</td><td>-</td><td>-</td></tr>
</table>

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

Course Objectives: The objectives of this course is to provide the knowledge to understand the fundamental laws of static and dynamic electric and magnetic fields and apply electromagnetic fields and waves theory in the generation, transmission and measurement techniques.

1. Introduction: **(3hrs)**

1.1 Scalars and vectors

1.2 Vector algebra

1.3 Coordinate system: Cartesian, Cylindrical and Spherical

1.4 Scalar and vector operations in different coordinate systems

2. Electric Field Intensity: **(3hrs)**

2.1 Coulomb's law

2.2 Electric field intensity

2.3 Field due to point charges, line charge and sheet of charge

3. Gauss's Law and Applications: (3hrs)

- 3.1 Electric flux density
- 3.2 Gauss' s law in integral form
- 3.3 Application of Gauss's law: point, line, sheet charge
- 3.4 Boundary condition at a conductor surface

4. Divergence: (3hrs)

- 4.1 Physical significance of Divergence
- 4.2 Maxwell's first equation and applications
- 4.3 Divergence theorem and application

5. Energy and Potential: (4hrs)

- 5.1 Electric energy
- 5.2 Potential and Potential difference
- 5.3 Potential field of a point charge and system of charges
- 5.4 Potential gradient
- 5.5 Electric intensity as the negative gradient of a scalar potential
- 5.6 Conservative fields
- 5.7 Electric energy density

6. Electrostatic Field in Material Media: (2hrs)

- 6.1 Polarization
- 6.2 Free and bound charge densities
- 6.3 Relative permittivity
- 6.4 Capacitance Calculations: parallel plates and concentric

7. Boundary Value Problems in Electrostatics: (4hrs)

- 7.1 Laplace's and Poisson's equations
- 7.2 Uniqueness theorem
- 7.3 One-dimensional and two-dimensional boundary value problems

8. Current and current density: (2hrs)

8.1 Conversation of charge
8.2 Continuity of current
8.3 Point form of Ohm's law
8.4 Relaxation time constant

9. Magnetic force and material: (2hr)

11.1 Magnetic force and magnetic moment on a moving charge
11.2 Force on a differential current element
11.3 Classification of magnetic materials
11.4 Magnetization and permeability
11.5 Magnetic circuits

10. Magnetostatics: (2hrs)

9.1 Magnetic field intensity and magnetic flux density
9.2 Biot-Savart's Law and its applications
9.3 Ampere's circuital law and its applications

11. Curl: (3hrs)

10.1 Physical significance of Curl
10.2 Stoke's theorem
10.3 Ampere's law in point form
10.4 Scalar and vector magnetic potentials
10.5 Boundary value problems

12. Time- Varying fields and Maxwell's Equations: (3hrs)

12.1 Faraday's law
12.2 Inadequacy of Ampere's law with direct current, Conflict with continuity equation, Displacement current
12.3 Maxwell's equation in point form, Maxwell's equation in integral form
12.4 Retarded potential

13. Wave Equation and Propagation: (7hrs)

13.1 Wave propagation in free space, perfect dielectric and lossy medium
13.2 Wave impedance, Skin effect, A.C. resistance
13.3 Poynting vector
13.4 Reflection of uniform plane waves: Reflection and Transmission coefficients
13.5 Standing wave ratio
13.6 Impedance matching

14. Transmission Lines: (4hrs)

14.1 Introduction
14.2 Physical Description of Transmission line propagation
14.3 Transmission line equations
14.4 Lossless propagations: Characteristic impedance, input impedance, phase constant, phase velocity

Note: Expressions for Gradient, Divergence, Curl and Laplacian of Cylindrical and Spherical coordinate system must be proposed in final exam.

Laboratory:

l. Coordinate Conversion

2. Measurement of Dielectric Constant

3. Electric Field Plotting- Regular and regular Shape

4. Transmission Line Parameters using simulation software

5. Waveguide Familiarization

6. Magnetic Field measurements in a static magnetic circuit

Reference Books:

1. V. H. Hayt, "Engineering Electromagnetic",TataMcGraw Hill Book Co., New Delhi

2. J.D. Kraus & K. R. Carver, "Electromagnetics"

3. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press

Detailed Course Contents of Electromagnetics

Note: Define(SD), Description (D), Derive (Dr), Illustration (I), Explanation (E), Application (A), Experimentation (Ex), Numerical (N)

Ch No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
1	Introduction	1.1	Scalars and vectors	✓								3
		1.2	Vector algebra	✓								
		1.3	Coordinate system: Cartesian, Cylindrical and Spherical		✓						✓	
		1.4	Scalar and vector operations in different coordinate systems		✓						✓	
2	Electric Field Intensity	2.1	Coulomb's law	✓								3
		2.2	Electric field intensity	✓	✓						✓	
		2.3	Field due to point charge, line charge and sheet of charge			✓					✓	
3	Gauss's Law and Applications	3.1	Electric flux density	✓								3
		3.2	Gauss' s law in integral form			✓						
		3.3	Application of Gauss's law: Point, line, sheet charge			✓						

		3.4	Boundary condition at a conductor surface			✓						
4	Divergence	4.1	Physical significance of Divergence					✓				**3**
		4.2	Maxwell's first equation and applications		✓				✓		✓	
		4.3	Divergence theorem and application			✓	✓		✓			
5	Energy and Potential	5.1	Electric energy	✓								**4**
		5.2	Potential and Potential difference	✓		✓						
		5.3	Potential field of a point charge and system of charges			✓					✓	
		5.4	Potential gradient	✓								
		5.5	Electric intensity as the negative gradient of a scalar potential			✓						
		5.6	Conservative fields	✓								
		5.7	Electric energy density	✓		✓					✓	
6	Electrostatic Field in Material Media	6.1	Polarization	✓								**2**
		6.2	Free and bound charge densities	✓								
		6.3	Relative permittivity	✓								
		6.4	Capacitance Calculations: parallel plates and concentric			✓					✓	

7	Boundary Value Problems in Electrostatics	7.1	Laplace's and Poisson's equations	✓		✓					✓	**4**
		7.2	Uniqueness theorem			✓						
		7.3	One-dimensional and two-dimensional boundary value problems			✓						
8	Current and current density	8.1	Conversation of charge	✓								**2**
		8.2	Continuity of current			✓					✓	
		8.3	Point form of Ohm's law			✓					✓	
		8.4	Relaxation time constant			✓					✓	
9	Magnetic force and material	9.1	Magnetic force and magnetic moment in moving charge	✓								**2**
		9.2	Force on different current element	✓								
		9.3	Classification of magnetic material	✓								
		9.4	Magnetization and permeability	✓								
		9.5	Magnetic circuits	✓								
10	Magnetosatics	10.1	Magnetic field intensity and magnetic flux density	✓		✓						**2**
		10.2	Biot-Savart's Law and its applications			✓					✓	

		10.3	Ampere's circuital law and its applications			✓					✓	
11	Curl	11.1	Physical significance of Curl	✓								**3**
		11.2	Stoke's theorem					✓			✓	
		11.3	Ampere's law in point form			✓						
		11.4	Scalar and vector magnetic potentials			✓			✓			
		11.5	Boundary value problems			✓						
12	Time- Varying fields and Maxwell's Equations:	12.1	Faraday's law									**3**
		12.2	Inadequacy of Ampere's law with direct current, Conflict with continuity equation, Displacement current			✓						
		12.3	Maxwell's equation in point form, Maxwell's equation in integral form			✓		✓			✓	
		12.4	Retarded potential			✓		✓				
13	Wave Equation and Propagation	13.1	Wave propagation in free space, perfect dielectric and lossy medium	✓		✓						**7**
		13.2	Wave impedance, Skin effect, A.C. resistance	✓								
		13.3	Poynting vector	✓		✓						
		13.4	Reflection of uniform plane waves: Reflection and Transmission coefficients			✓						

		13.5	Standing wave ratio	✓		✓						
		13.6	Impedance matching	✓								
14	Transmission Lines	14.1	Introduction	✓								**4**
		14.2	Physical Description of Transmission line propagation					✓				
		14.3	Transmission line equations , parameter					✓				
		14.4	Lossless propagations: Characteristic impedance, input impedance, phase constant, phase velocity	✓							✓	

Note: Expressions for Gradient, Divergence, Curl and Laplacian of Cylindrical and Spherical coordinate system must be proposed in final exam.

Laboratory:

l. Coordinate Conversion

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Final Examination Scheme:

Chapters	Marks	Remarks
1	2	
2	4	
3	4	
4	4	
5	4	
6	2	
7	4	
8	4	
9	2	

10	**4**	
11	**4**	
12	**6**	
13	**10**	
14	**6**	
Total	**60**	
Note: There might be minor deviation in mark distribution. ***Mandatory: Marks should be evaluated based on solving steps.***		

Evaluation Scheme;
Marks Division

Question Type	No. of Questions	Marks	Total Marks
Short	4	2	8
Medium	7	4	28
Long	3	8	24
Total			60

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PURBANCHAL UNIVERSITY

Model Question 2023

LEVEL:- B.E. Electrical/Fourth Semester

SUBJECT:- Electromagnetics

FULL MARKS:- 60

TIME:- 03:00 hrs PASS MARKS:- 24

Candidates are required to give their answers in their own words as far as practicable.

Attempt All Questions.

Group A (4x2=8)

1. Define scalar and vector.
2. Differentiate between Vector magnetic potential and Scalar magnetic potential.
3. State and prove gauss law.
4. What do you mean by skin effect?

Group B (7x4 = 28)

5. Select the value of k so that each of the following pairs of fields satisfies Maxwell's equations in a region where $\sigma = 0$ and ρ_v=0.

   (a) E = (kx- 100t)a_y V/m, H = (x+ 20t)a_z A/m if μ=0.25H/m & ϵ= 0.01F/m

   (b) D = 5xa_x - 2ya_y + kza_z μC/m^2, B = 2a_y mT, $\mu = \mu_o$, $\epsilon = \epsilon_o$
6. A uniform sheet of charge $\rho_S = 50\varepsilon_0 C/m^2$ is located in the plane $x = 0$ in free space. A uniform line charge $\rho_L = 10nC/m$ lies along the line $x = 9, y = 4$ in free space. Find the potential at point (5,7,-4) if $V = 10V$ at A (2,9,3).
7. Find magnetic field intensity due to infinitely long filament using Ampere's Circuital law.
8. State and prove divergence theorem.
9. Find the capacitance of parallel plate capacitor.
10. Evaluate both side of Stokes' theorem for field H=6xya x -3y 2 a y A/m about the rectangular path P(5,1,0) to Q(2,1,0) to R(2,-1,0) to S(5,-1,0) to P.
11. State and derive continuity equation.

Group C (8X3=24)

12. Define the term attenuation constant and Phase constant. A uniform plane wave in free space is given by

$E_s = (200 \measuredangle 30^\circ) e^{-j250z}\, a_x$ V/m. Find: (a) β (b) ω (c) H_s (d) |E| at z = 8mm & t = 6ps. [2+6]

13. Define and explain the types of waveguide. Lossless transmission line with Zo=60 ohm is 400m long. It terminated with load Z_L = 400 + j80 ohm and operated at 1 MHZ. Let v= 0.8c find: reflection coefficient, Standing wave ratio and input impedance. [4+4]
14. Derive uniqueness theorem. Explain its significance. [8]

NOTE: Following Formulas provided with question in final exam

For Cylindrical system

$$\nabla f = \frac{\partial f}{\partial \rho}\hat{\boldsymbol{\rho}} + \frac{1}{\rho}\frac{\partial f}{\partial \varphi}\hat{\boldsymbol{\varphi}} + \frac{\partial f}{\partial z}\hat{\boldsymbol{z}}$$

$$\nabla \cdot \boldsymbol{A} = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho A_\rho) + \frac{1}{\rho}\frac{\partial A_\varphi}{\partial \varphi} + \frac{\partial A_z}{\partial z}$$

$$\nabla \times \boldsymbol{A} = \left(\frac{1}{\rho}\frac{\partial A_z}{\partial \varphi} - \frac{\partial A_\varphi}{\partial z}\right)\hat{\boldsymbol{\rho}} + \left(\frac{\partial A_\rho}{\partial z} - \frac{\partial A_z}{\partial \rho}\right)\hat{\boldsymbol{\varphi}} + \frac{1}{\rho}\left(\frac{\partial}{\partial \rho}(\rho A_\varphi) - \frac{\partial A_\rho}{\partial \varphi}\right)\hat{\boldsymbol{z}}$$

$$\nabla^2 f = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial f}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 f}{\partial \varphi^2} + \frac{\partial^2 f}{\partial z^2}$$

For spherical system:

$$\nabla f = \frac{\partial f}{\partial r}\hat{\mathbf{r}} + \frac{1}{r}\frac{\partial f}{\partial \theta}\hat{\boldsymbol{\theta}} + \frac{1}{r\sin\theta}\frac{\partial f}{\partial \varphi}\hat{\boldsymbol{\varphi}},$$

$$\nabla \cdot \mathbf{A} = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 A_r\right) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta A_\theta) + \frac{1}{r\sin\theta}\frac{\partial A_\varphi}{\partial \varphi},$$

$$\begin{aligned}\nabla \times \mathbf{A} = {} & \frac{1}{r\sin\theta}\left(\frac{\partial}{\partial \theta}(A_\varphi \sin\theta) - \frac{\partial A_\theta}{\partial \varphi}\right)\hat{\mathbf{r}} \\ & + \frac{1}{r}\left(\frac{1}{\sin\theta}\frac{\partial A_r}{\partial \varphi} - \frac{\partial}{\partial r}(rA_\varphi)\right)\hat{\boldsymbol{\theta}} \\ & + \frac{1}{r}\left(\frac{\partial}{\partial r}(rA_\theta) - \frac{\partial A_r}{\partial \theta}\right)\hat{\boldsymbol{\varphi}},\end{aligned}$$

$$\begin{aligned}\nabla^2 f &= \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial f}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial f}{\partial \theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 f}{\partial \varphi^2} \\ &= \left(\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r}\right)f + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial}{\partial \theta}\right)f + \frac{1}{r^2\sin^2\theta}\frac{\partial^2}{\partial \varphi^2}f.\end{aligned}$$

Purbanchal University

Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Electrical Engineering
Subject: Electrical Machine

Year-II **Semester-**IV

<table>
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<tr><td>3</td><td>3</td><td>1</td><td>3/2</td><td>5.5</td><td>3 Hrs.</td><td>60</td><td>-</td><td>15</td></tr>
</table>

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

Course Objectives:

1. To apply the principles of electric and magnetic circuits for electromechanical energy conversion.
2. To impart knowledge on constructional details, operating principle and performance of Transformer, DC Machine and 3-phase induction motor.
3. To understand the application of electrical machines.

1. Introduction **6 Hrs**

Magnetic Materials: Ferromagnetic Materials and Properties; Magnetic circuits and its types; Faradays Laws of Electromagnetic induction: Self & Mutual induction; Hysteresis Curve and Hysteresis losses, Eddy current losses; Ampere's law & Force on current carrying Conductor

2. Transformers **12 hrs**

Construction Details, Working Principle; Derivation of EMF equation, Ideal Transformer; Transformer on No-load, Transformer on load, Real Transformer & equivalent Circuit; Losses in Transformer, efficiency; Tests on Transformer: Polarity Test, Open Circuit Test & Short Circuit Test;, Voltage Regulation; Auto Transformer; Instrument Transformer (current & Voltage Transformer); Three Phase Transformer, Parallel operation of Transformer; Three Phase Transformer Connection (Y/Y,Y/Δ,Δ/Y, Δ/Δ and V/V (or open Δ) connections)

3. DC Generator **8 hrs**

Construction; Working Principle of DC Generator, EMF Equation; Method of Excitation & types based on excitation; Armature Reaction & Commutation; Characteristics of DC Generators; Losses in Dc Generators, Efficiency & Voltage Regulation

4. DC Motor **8 hrs**

Construction & Working Principle of DC Motor; Characteristics of Dc Motor; DC Motor Starter :3 & 4 Point Starter; Speed Control of DC Motor; losses, Efficiency & Application of DC Motor
Reversing of DC Motor

5. Three-Phase Induction Machines **11 hrs**

Construction Details & Types; Operating Principle; Rotating Magnetic Field, Synchronous Speed, Slip, Induced EMF; Torque Equation, Torque-Slip Characteristics; Effect of Rotor resistance on Torque-Slip Characteristics, Losses, Power Stages & Efficiency; Starting Methods; Speed Control Methods; Three Phase Induction Generator: Working Principle & Voltage Build up; Power Stages in three phase induction machine, Isolated & Grid Connected Mode

Practical: There shall be at least 6 Laboratories related to following topics

1. Magnetic Circuits

• To draw B-H curve for two different sample of Iron Core
• Compare their relative permeabilities

2. Two Winding Transformers

• To perform turn ratio test
• To perform open circuit (OC) and short circuit (SC) test to determine equivalent circuit parameter of a transformer and hence to determine the regulation and efficiency at full load

3. DC Generator

• To draw open circuit characteristic (OCC) of a DC shunt generator and to calculate: (a) Maximum voltage built up (a) Critical resistance and critical speed of the machine
• To draw load characteristic of shunt generator

4. DC Motor

• Speed control of DC Shunt motor by (a) armature control method (b) field control method

• To observe the effect of increasing load on DC shunt motor's speed, armature current, and field current.

5. 3-phase Induction Machines

• To draw torque-speed characteristics and to observe the effect of rotor resistance on torque-speed characteristics

• To perform no load and blocked rotor test to evaluate equivalent circuit parameters

.

References:

1. I.J. Nagrath & D.P. Kothari," Electrical Machines", Tata McGraw Hill
2. S. K. Bhattacharya, "Electrical Machines", Tata McGraw Hill
3. Husain Ashfaq , "Electrical Machines", Dhanpat Rai & Sons
4. B.L Theraja, "Text book of Electrical Technology" vol. 2
5. P. S. Bhimbra, "Electrical Machines"' Khanna Publishers
6. Irving L. Kosow, "Electric Machine and Transformers", Prentice Hall of India.
7. J.B Gupta, "Theory and performance of Electrical Machines"

Chapter Wise Marks Distribution for Final Examination

SN	Chapter	Lecture hour	Marks Distribution	Types of Questions			Remarks
				Very Short	Short	Long	
1	Introduction	6	8	✓	✓	✓	(2 very short + 1 short) OR (2 short or 1 long)
2	Transformers	12	16	✓	✓	✓	(2 very short + 1 short + 1 long) OR (2 short + 1 long)
3	DC Generator	8	10	✓	✓	✓	(1 very short + 2 short) OR 1 very short + 1 long
4	DC Motor	8	10	✓	✓	✓	(1 very short + 2 short) OR (1 very short + 1 long)

5	3 Phase Induction Machines	11	16	✓	✓	✓	(2 very short + 1 short + 1 long) OR (2 short + 1 long)
	Total	45	60	4	7	3	

Note: ***All the questions in very short type must be theoretical questions. There shall be 4 very short questions each carrying 2 marks.***

In Short type questions there can't be any breakdown and question can be theoretical/derivational or numerical question. There shall be 7 short questions each carrying 4 marks.

In Long type question there can be some breakdown and questions may be numerical/Derivational/ Theoretical. There shall be 3 long questions each carrying 8 marks.

PURBANCHAL UNIVERSITY

Model Question 2023

Bachelor in Electrical Engineering/Fourth Semester/Final

Time: 03:00 hrs. Full Marks:60

(Subject code): Electrical Machine Pass Marks:24

Candidates are required to give their answers in their own words as far as practicable.

Group-A

Very Short Questions **(2*4=8)**

1. List the assumption made for an ideal transformer (Chapter-2)

2. Mention different types of losses in transformer. (Chapter-2)

3. List the role of back emf in dc motor. (Chapter-4)

4. Define Critical speed and critical resistance. (Chapter-3)

Group-B

Short Questions **(4*7=28)**

1. Define coercivity and retentivity with the help of BH curve. (Chapter-1)
2. An iron ring has a mean length of 2m and cross-sectional area of $0.01m^2$. It has a radial air gap of 4mm. The ring is wound with 250 turns. What current would be needed in the coil to produce a flux of 0.8wb in the air gap? Assume relative permeability is 400. (Chapter-1)
3. State and explain short circuit test on transformer. (Chapter-2)
4. Define excitation and mention the types of DC generator based on excitation. (Chapter-3)
5. A short shunt compound generator delivers a load current of 30 A at 220V and has armature, series and shunt field resistance of 0.05Ω, 0.03Ω and 200Ω respectively. Calculate the induced emf and the armature current. Allow 1V per brush contact drop. (Chapter-3)
6. Explain the working principle of Induction motor. (Chapter-5)
7. Derive the condition for maximum torque of a 3-phase induction motor under running condition.

Group-C

Long Questions **(8*3=24)**

1. A 30 kVA, 200/2000V single phase transformer has following test results: (Chapter-2)

O.C Test:	**200V**	**6.2A**	**360W**
S.C Test:	**75V**	**18A**	**600W**

Obtain equivalent circuit parameters referred to primary side and draw the equivalent circuit

2. A DC shunt motor is supplied by a source of 200 V. It draws a current of 20 A an runs at speed of 1500 rpm. The armature and field winding resistance are 0.08 and 110 ohm respectively. A resistance of 0.02 ohm is added in series with armature and load torque is increased by 30%, Calculate new speed.

(Chapter 4)

OR

Explain the speed control of DC series motor (Chapter 4)

3.A 6-pole, 50 Hz, 3-phase induction motor has rotor resistance of 0.4Ω/phase, maximum torque is 200Nm at 850 rpm. Find (i) torque at 4% slip (ii) additional rotor resistance to get $(2/3)^{rd}$ of maximum torque at starting. (Chapter-5)

Micro syllabus of Electrical Machine

Note: Define(SD), Description(D), Derive(Dr), Illustration(I), Explanation(E), Application(A), Experimental(Ex), Numerical(N)

Chapters Number	Topic	SubTopic	Depth									Hours	Remarks
			SD	D	Dr	I	E	E	A	Ex	N		
Chapter 1:		1.1 Magnetic Materials: Ferromagnetic Materials and Properties	✓	✓			✓	✓	✓			1	
		1.2 Magnetic circuits and its types	✓	✓	✓		✓	✓			✓	2	
		1.3 Faradays Laws of Electromagnetic induction: Self Induction	✓	✓	✓		✓	✓	✓		✓	1	
		1.3 Mutual Induction	✓	✓	✓		✓	✓			✓	2	
		1.4 Hysteresis Curve, Hysteresis losses, and its determination	✓	✓	✓	✓	✓	✓	✓		✓		

	Introduction No. of Hours: 6	1.5 Eddy current losses	✓	✓							✓		
		1.6 Ampere’s law & Force on current carrying Conductor	✓	✓									
Chapter 2:	Transformers No. of Hours: 12	2.1 Construction Details, Working Principle and its types	✓	✓		✓	✓	✓				1	
		2.2 EMF equation, Ideal Transformer			✓	✓	✓	✓			✓		
		2.3 Transformer on No-load, and Transformer on load	✓	✓	✓	✓	✓	✓			✓	2	
		2.4 Real Transformer & equivalent Circuit, Transformation of impedance	✓	✓	✓	✓					✓	2	
		2.5 Losses in Transformer, efficiency: all day and commercial	✓	✓	✓		✓	✓			✓	2	

		and Condition for maximum efficiency											
		2.6 Tests on Transformer: Polarity, Open & Short Circuit Test	✓	✓	✓	✓	✓	✓			✓	1	
		2.7 Voltage Regulation,	✓	✓	✓	✓	✓	✓			✓	1	
		2.8 Auto Transformer: CU saving and its application Instrument Transformer (current & Voltage Transformer)	✓	✓	✓	✓	✓	✓	✓			1	
		2.9 Three Phase Transformer and their Connection, Parallel operation of Transformer and load sharing (only derivation)	✓	✓	✓	✓	✓	✓	✓			2	
Chapter 3:		3.1 Construction	✓	✓		✓	✓	✓				2	

		3.2 Working Principle of DC Generator, EMF Equation	✓	✓	✓	✓	✓	✓			✓		
	DC Generator No. of Hours: 8	3.3 Method of Excitation & types based on excitation	✓	✓		✓	✓	✓	✓		✓	2	
		3.4 Armature Reaction, Commutation, Compensating windings and interpoles	✓	✓		✓	✓	✓				2	
		3.5 Characteristics of DC Generators, Voltage Build up process and Causes of failure of voltage build up	✓	✓		✓	✓	✓				1	
		3.6 Losses, Efficiency: Electrical. Mechanical and overall & Voltage Regulation	✓	✓	✓		✓	✓			✓	1	

Chapter 4:	DC Motor No. of Hours: 8	4.1 Construction & Working Principle of DC Motor and role of back emf	✓	✓		✓	✓	✓				3	
		4.2 Torque Equation and Types and Characteristics of DC Motor		✓	✓	✓	✓	✓			✓		
		4.3 DC Motor Starter :3 & 4 Point Starter	✓	✓		✓	✓	✓				3	
		4.4 Speed Control of DC Motor	✓	✓		✓	✓	✓			✓		
		4.6 losses, Efficiency & Application of DC Motor	✓	✓			✓	✓	✓		✓	1	
		4.7 Reversing of DC Motor	✓	✓		✓	✓	✓					
		4.8 Power stages in DC machines	✓	✓		✓	✓	✓				1	

Chapter 5:	Three Phase Induction Machines	5.1 Construction Details & Types	✓	✓		✓	✓	✓				2	
		5.2 Operating Principle: concept of rotating magnetic field		✓	✓	✓	✓	✓					
		5.3 Synchronous Speed, Slip, Induced EMF, rotor current and its frequency	✓	✓	✓	✓	✓	✓			✓	2	
		5.4 Torque Equation and condition for maximum torque		✓	✓						✓		
		5.5 Torque-Slip Characteristics, Effect of Rotor resistance on Torque-Slip Characteristics, Testing of 3 phase IM	✓	✓		✓	✓	✓			✓	2	
		5.6 Starting Method: DOL, Primary Resistors, Star-Delta,	✓	✓		✓	✓	✓				1	

	No. of Hours:11	Autotransformer, Cascade Connection											
		5.7 Speed Control Methods	✓	✓		✓	✓	✓				1	
		5.8 Three Phase Induction Generator: Working Principle & Voltage Build up	✓	✓		✓	✓	✓	✓			2	
		5.9 Losses, Efficiency and Power Stages of Induction Machines, Isolated & Grid Connected Mode	✓	✓		✓	✓	✓			✓	1	

Purbanchal University

Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Electrical Engineering
Subject: Power System Analysis-I

Year-II **Semester-**IV

Teaching Schedule Hours/Week					Examination Schedule						Total Marks
					Final				Internal Assessment		
					Theory		Practical		Theory Marks	Practical Marks	
Credit Hours	L	T	P	Total	Duration	Marks	Duration	Marks	40	10	125
3	3	1	3/2	5.5	3 Hrs.	60	-	15			

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

Course Objective:
The course aim to deliver the basic principle and fundamental analysis techniques for generation, transmission and distribution components of a power system as a first course in power system

1. **Introduction to Power System (6 hours)**
   Power System Evolution; Generation, Transmission and Distribution Components; Energy Sources; hydro, thermal, Nuclear; Photovoltaic, Wind, geothermal energy sources; Major electrical components in power station; Alternators, transformers, bus bars, voltage regulators, switch and isolators, metering and control panels; Infinite bus concept; Voltage levels, AC & DC Transmission; Single phase and three phase power delivery

2. **Overhead & Underground Transmission (8 hours)**

Line supports, spacing between conductors; Transmission line conductor materials; Stranded and bundled conductors; Overhead line insulators, its types; Voltage distribution along string of suspension insulators, string efficiency; Classification and construction of underground cables, insulation resistance; Dielectric stress in single core/multi core cables; Cable faults and location of faults

3. **Computational Technique (6hours)**
   Single phase representation of three phase system; Impedance and reactance diagram; Single line diagram; Complex powers; Direction of power flow; Per unit system; advantage and applications

4. **Line parameter calculations (12 hours)**
   Inductance, resistance and capacitance of a line; Inductance of line due to internal & external flux linkages; Skin & proximity effect; Inductance of single phase two wire line, stranded & bundled conductor consideration, concept of G.M.R and G.M.D, inductance of three phase line; equilateral and unsymmetrical spacing; Transposition, inductance of double circuit three phase lines; G.M.R and G. M.D for capacitance calculations; Capacitance calculations of single phase two wire line, stranded & bundled conductor consideration, capacitance of three phase line; equilateral and unsymmetrical spacing, double circuit; Earth effect in capacitance of a line

5. **Transmission line modeling (5 hours)**
   Classification of a lines based on short, medium and long transmission lines; Representation of ‘T’ and ‘π’ of medium transmission lines; Distributed Parameter model of long transmission lines; ABCD parameters in medium and long transmission lines; Equivalent ‘T’ and ‘π’ of long transmission lines

6. **Performance Analysis (8 hours)**
   Relationship between Sending and receiving end quantities; Voltage regulation & efficiency of transmission lines; Transmission line as source and sink of reactive power; Real and reactive power flow through lines; Surge impedance loading; High capacitance effect of long lines; Reactive compensation of transmission lines

Laboratory:

There shall be at least 6 laboratories involving following topics (Using suitable simulation software)

1. Model of a Power System Network
2. Complex Power Measurement drawing a single line diagram
3. DC network analysis
4. Transmission line modelling (short, medium, long)
5. Performance analysis of transmission line

References:

1. W.D. Stevension "Power System Analysis", Tata McGraw Hill Publications
2. I.J Nagrath and D.P Kothari ,"Modern Power system analysis", Tata McGraw Hill Publications
3. B.R. Gupta ,"Power System Analysis and Design" S Chand & Company Limited
4. S.N. Singh, "Electric power Generation, Transmission & Distribution", Prentice Hall India
5. J.B Gupta ,"A Course in Power Systems" , SK Kataria and Sons

Chapter Wise Marks Distribution for Final Examination

SN	Chapter	Lecture hour	Marks distribution	Types of Questions			Remarks
				Very Short	Short	Long	
1	Chapter 1	6	6	✓	✓	-	(1 Very short + 1 short)
2	Chapter 2	8	10	✓	✓	✓	(1Very short+2short) or (1 very short +1 long)
3	Chapter 3	6	10	✓	✓	✓	(1Very short+2short) or (1 very short +1 long)
4	Chapter 4	12	14	✓	✓	✓	(1 Very short + 1 short +1 long)
5	Chapter 5	5	8	✓	✓	✓	(2Very short+1short) or (2 short) or (1 long)
6	Chapter 6	8	12	✓	✓	✓	(2Very short+2short) or(1 very short + 2 short) or (1short+1 long)
	Total	45	60				

Note:* *All the questions in very short type must be theoretical questions. There shall be 4 very short questions each carrying 2 marks.

In Short type questions there can't be any breakdown and question can be theoretical/derivational/numerical question. There shall be 7 short questions each carrying 4 marks.

In Long type question there can be some breakdown and questions may be numerical/Derivational/ Theoretical. There shall be 3 long questions each carrying 8 marks.

PURBANCHAL UNIVERSITY

Model Question 2023

B.E. (Electrical)/Fourth Semester

Time: 03:00 hrs. Full Marks: 60 /Pass Marks: 24

(Subject code): Power System Analysis-I

Candidates are required to give their answers in their own words as far as practicable.
The marks allotted for each sub-question is specified along its side. Assume necessary data if required.

Group A (Very short questions) **4x2=8**

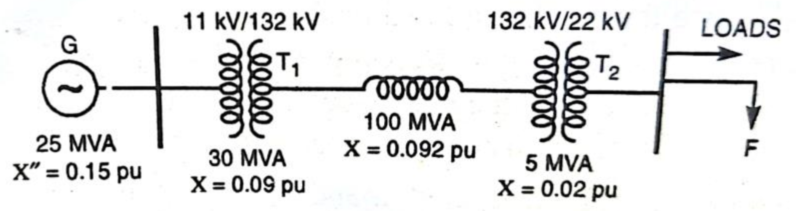
1. What are the main divisions of power system? (Chapter 1)
2. On what factors spacing between conductors depends upon? (Chapter 2)
3. What are the advantages of per unit system? (Chapter 3)
4. What is skin effect? (Chapter 4)

Group B (Short questions) **7x4=28**

5. Justify the need of interconnection of different generating station by high voltage lines to form a power grid? (Chapter 1)
6. Explain the construction of cable with neat diagram. (Chapter 2)
7. Explain the effect of ice and wind on transmission line. (Chapter 2)
8. Calculate the capacitance to neutral 1 km of single phase line composed of 2 single strand conductors (radius = 0.328 cm) spaced 3m apart and 7.5 m above the ground. Compare result obtained. (Chapter 4)
9. Classify transmission line on the basis of line length and briefly explain about them. (Chapter 5)
10. A 3 phase, 50 Hz, 16 km long overhead line supplies 1000 kW at 11 kV, 0.8 p.f lagging. The line resistance is 0.03 Ω per phase per km and line inductance is 0.7 mH per phase per km. Calculate sending end voltage and voltage regulation of transmission line. (Chapter 5)
11. Derive the expression of voltage regulation of transmission line. (Chapter 6)

Group C (Long questions) **3x8=24**

12. Determine per unit values on the base of ratings of generator G. Also draw the impedance diagram of the system. (Chapter 3)



13. Derive formula for inductance of phase line due to symmetrical as well as due to unsymmetrical spacing between conductors. (Chapter 4)

14. For a 3 phase overhead line, the following data is available.

$V_{SL} = 138.5\angle 8^0$ KV $V_{RL} = 132\angle 0^0$ KV

$A = 0.983\angle 0.68^0\ \Omega$ $B = 36.5\angle 71.5^0\ \Omega$

Determine the transmission line active and reactive power loss. (Chapter 6)

Or

What do you mean by reactive compensation of transmission line. Explain the various types of compensating technique of reactive power.

Micro syllabus of Power System Analysis I

Note: Define(SD), Description(D), Derive(Dr), Illustration(I), Explanation(E), Application(A), Experimental(Ex), Numerical(N)

Ch No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
1	Introduction to Power System	1.1	Power System Evolution		✓			✓				1	
		1.2	Generation, Transmission and Distribution Components		✓		✓	✓					
		1.3	Energy Sources; hydro, thermal, Nuclear; Photovoltaic, Wind, geothermal		✓			✓	✓			3	
		1.4	Major electrical components in power station; Alternators, transformers, bus bars, voltage regulators, switch and isolators, metering and control panels		✓			✓	✓			1	
		1.5	Infinite bus concept	✓	✓			✓				1	
		1.6	Voltage levels, AC & DC Transmission		✓			✓					
		1.7	Single phase and three phase power delivery		✓			✓					
2		2.1	Line supports, spacing between conductors	✓	✓			✓				1	

	Overhead & Underground Transmission	2.2	Transmission line conductor materials		✓			✓					
		2.3	Stranded and bundled conductors	✓	✓			✓				1	
		2.4	Overhead line insulators, its types	✓	✓			✓					
		2.5	Voltage distribution along string of suspension insulators, string efficiency		✓	✓		✓			✓	2	
		2.6	Classification, construction of underground cables, insulation resistance		✓	✓		✓				1	
		2.7	Dielectric stress in single core/multi core cables		✓	✓		✓				1	
		2.8	Cable faults and location of faults		✓	✓		✓			✓	2	
3	Computational Technique	3.1	Single phase representation of three phase system		✓			✓				1	
		3.2	Impedance and reactance diagram		✓		✓	✓				1	
		3.3	Single line diagram		✓		✓	✓			✓	2	
		3.4	Complex powers	✓	✓			✓			✓	1	
		3.5	Direction of power flow		✓	✓					✓	1	
		3.6	Per unit system; advantage and applications	✓	✓				✓				

4	Line parameter calculations	4.1	Inductance, resistance and capacitance of a line	✓									
		4.2	Inductance of line due to internal & external flux linkages	✓	✓	✓					✓	3	
		4.3	Skin & proximity effect	✓	✓			✓					
		4.4	Inductance of single phase two wire line, stranded & bundled conductor consideration, concept of G.M.R and G.M.D, inductance of 3 phase line; equilateral and unsymmetrical spacing		✓	✓					✓	2	
		4.5	Transposition, inductance of double circuit 3 phase lines		✓	✓					✓	2	
		4.6	Concept of G.M.R and G. M.D for capacitance calculations			✓					✓	1	
		4.7	Capacitance calculations of single phase two wire line, stranded & bundled conductor consideration, capacitance of 3 phase line; equilateral and unsymmetrical spacing, double circuit			✓					✓	3	
		4.8	Earth effect in capacitance of a line			✓					✓	1	
5	Transmission line modeling	5.1	Classification of a lines based on short, medium and long lines		✓			✓					

		5.2	Representation of 'Tee' and 'Pi'of medium lines; calculation of ABCD parameters		✓	✓					✓	2	
		5.3	Distributed Parameter model of Long lines; calculation of ABCDparameters		✓			✓			✓	3	
		5.4	Equivalent 'Tee' and 'Pi' of longlines			✓					✓		
6	Performance Analysis	6.1	Sending and receiving endquantities analysis		✓	✓						2	
		6.2	Voltage regulation & efficiency calculation of transmission lines		✓	✓					✓		
		6.3	Transmission line as source andsink of reactive power		✓		✓	✓			✓	2	
		6.4	Real and reactive power flowthrough lines			✓					✓		
		6.5	Surge impedance loading		✓	✓		✓			✓	2	
		6.6	High capacitance effect of longlines		✓			✓					
		6.7	Reactive compensation of transmission lines		✓			✓				2	
		6.8	Sending and receiving end quantities analysis			✓					✓		

Purbanchal University
Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Electrical Engineering
Subject: Instrumentation

Year-II **Semester-**IV

Teaching Schedule Hours/Week					Examination Schedule						Total Marks
					Final				Internal Assessment		
					Theory		Practical		Theory Marks	Practical Marks	
Credit Hours	L	T	P	Total	Duration	Marks	Duration	Marks	40	10	125
3	3	1	3/2	5.5	3 Hrs.	60	-	15			

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

Course Objectives: To impart a good working knowledge of method and instrument for a wide range of measurement problems

1. **Introduction (4 Hours)**

   Significance of measurement; Methods of measurements; Classification of instruments; Types of instrumentation system; Elements of generalized measurement system; Input output configuration of measuring instrument and measurement system; Guided and Unguided media; General telemetry

2. **Theory of Instrument and errors (8 Hours)**

   Measurement system performance; Static calibration and static characteristics; True value and errors in measurements; Static errors and correction; Scale range and scale space; Noise S/N ratio and sources of noise; Accuracy and precision; Significant figures; Static sensitivity and linearity; Hysteresis, Threshold, dead time, resolution and dead zone; Loading effect of shunt connected instrument; Loading effect of series connected instrument; Dynamic characteristics; Dynamic response; Dynamic analysis (Time domain and frequency domain); Types of errors; Statistical treatment of data; Multi sample and single sample test

3. **Measurement of resistance, capacitance, inductance and frequency (6 Hours)**

   Medium resistance measurement (Wheatstone bridge); Low resistance measurement using Kelvin bridge; Measurement of insulation resistance; Measurement of earth resistance; General equation for ac bridge balance; Maxwell inductance and capacitance bridge; Wein's bridge

4. **Sensors and transducers (9 Hours)**

Sensing element (cantilever, spring, load cells, Burdon tube, bellows and flow meter); Electrical transducer and classification; Characteristics and choice of transducer; Resistive transducer (POTs, strain gauze, resistance thermometer, thermistor, thermocouple, LM 35); Variable inductance transducer (Self, Mutual and Production of Eddy current, LVDT); Capacitive transducer (Variation in area, variation in distance with differential arrangement and variation in dielectric); Piezo electric transducer; Hall effect transducer; Magneto resistor

5. **Digital Instrumentation (5 Hours)**

Resolution, Quantization, aperture time, and sampling; Sample and hold circuit; Data acquisition system; Interfacing with computer; Components of SCADA system; Smart meter (Block diagram and operation)

6. **Signal conditioning and processing (7 Hours)**

OPAMPs in inverting and non-inverting mode; Adder, subtractor, integrator, differentiator, and logarithmic amplifier using OPAMPs; Filter and its types; Interference and elimination; Grounding and shielding; Analog / Digital conversion; Analog to Digital converter (SAR & Dual slope); Digital to Analog converter (Binary weighted and R2R ladder network)

7. **Electrical Measuring equipment (6 Hours)**

Wattmeter: Types, working principle, Digital & Induction type; Energy meter: Types, Working Principle; Frequency meter: Types, Working Principle, Digital & Electrodynamometer type frequency meter; Power factor meter

Laboratory:

There shall be at least 6 laboratories involving following topics

1. Measurement of physical variables using various bridges.
2. Conversion of physical variables into electrical signal.
3. Signal conditioning (amplification and filtering).
4. Error measurements in instrumentation system.
5. Observation of interference in instrumentation and their remedy.
6. Conversion of analog signal into digital and digital into analog signal.
7. Measurement using smart meter

<u>References:</u>

1. A.D. Helfrick and W.D. Cooper, *"Modern Electronic Instrumentation and MeasurementTechniques*", Prentice Hall of India 1996.
2. S. Wolf and R.F.M. Smith, *"Student Reference Manual for Electronic InstrumentationLaboratories*", Prentice-Hall of India 1996
3. A. K. Sawhney, "*A Course in Electronic Measurements and Instrum*entation", Dhanapat Rai andSons, India, 2011
4. C.S. Rangan, G.R.Sarma, and V.S.V. Main, "*Instrumentation: Devices and Systems*", TataMcGraw Hill,

India, 1992
5. D.M. Considine, "*Process Instruments and Controls Handbooks*", McGraw Hill 1985.

Chapter Wise Marks Distribution for Final Examination

Note: ***All the questions in very short type must be theoretical questions. There shall be 4 very short questions each carrying 2 marks.***

In Short type questions there can't be any breakdown and question can be theoretical or numerical question. There shall be 7 short questions each carrying 4 marks.

In Long type question there can be some breakdown and questions may be numerical/Derivational/ Theoretical. There shall be 3 long questions each carrying 8 marks.

SN	Chapter	Lecture hour	Marks distribution	Types of Questions			Remarks
				Very Short	Short	Long	
1	Chapter 1	4	6	✓	✓	×	(1Very short+1short)
2	Chapter 2	8	10	✓	✓	✓	(1Very short+1long) or (1Very short+2 short)
3	Chapter 3	6	8	✓	✓	✓	(2 short) or (1 long)
4	Chapter 4	9	14	✓	✓	✓	(1 very short+1short+1long)
5	Chapter 5	5	6	✓	✓	×	(1Very short+1short)
6	Chapter 6	7	8	✓	✓	✓	(2 short) or (1 long)
7	Chapter 7	6	8	✓	✓	✓	(2 short)or (1 long)
	Total	45	60				

PURBANCHAL UNIVERSITY

Model Question 2023

B.E. (Electrical)/Third Semester
Time: 03:00 hrs. Full Marks: 60 /Pass Marks: 24
(Subject code) Instrumentation

Attempt all questions:

Group A 4X2=8

1. What are the application areas of instrumentation system? (Chapter 1)
2. What is sensitivity? (Chapter 2)
3. What is quantization error? (Chapter 5)
4. What are the advantages of using electrical transducers? (Chapter 4)

Group B 7X4 =28

5. Explain basic instrumentation system using block diagram. (Chapter 1)
6. Write about capacitive transducer working in variation of dielectric material. (Chapter 4)
7. Explain loading effect using suitable example. (Chapter 2)
8. 200 V is applied across two resistors of 300KΩ in series. A voltmeter of 200V/10000Ω is used to measure voltage across second resistor, find the % error in the voltage measured.(Chapter 2)
9. Explain about basic Data Acquisition System. (Chapter 5)
10. Find the SAR ADC output for a 6 bit converter if the input ac is 2.023V if the reference voltage is 5V. (Chapter 6)
11. Derive the expression for gain of non-inverting operational amplifier. (Chapter 6)

Group C 3X8=24

12. Explain the construction and operation of electrodynamometer type frequency meter. (Chapter 7)
13. Derive the condition for balanced and unbalanced Wheatstone bridge. (Chapter 3)
14. Explain about the working of strain gauze and calculate the gauze factor. (Chapter 4)

Marks distribution of this model set:

SN	Chapters	Number of questions in			Total Marks
		Group A	Group B	Group C	
1	Chapter 1	1	1	-	6
2	Chapter 2	1	2	-	10
3	Chapter 3	-	-	1	8
4	Chapter 4	1	1	1	14
5	Chapter 5	1	1	-	6
6	Chapter 6	-	2	-	8
7	Chapter 7	-	-	1	8

Purbanchal University
Faculty of Engineering, Biratnagar, Nepal

Syllabus

Level: Bachelor
Program: Bachelor in Electrical/ Electronics Communication & Automation Engineering
Subject: Numerical Methods

Year-II **Semester-**IV

Teaching Schedule Hours/Week					Examination Schedule						Total Marks
					Final				Internal Assessment		
					Theory		Practical		Theory Marks	Practical Marks	
Credit Hours	L	T	P	Total	Duration	Marks	Duration	Marks	40	25	125
3	3	1	3	7	3 Hrs.	60	-	-			

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

Course Objective:
After completion of this course, the students will be able to solve the engineering problems by using the theory of numerical Computational procedures

1. Introduction **(3 hrs)**

1.1. Numerical computing process
1.2. New trends in Numerical Computing
1.3. Application in Numerical Computing
1.4. Errors in numerical methods

2. Solution of non – Linear equation **(8 hrs)**

2.1. Iterative methods and stopping criteria
2.2. Bisection method & its Convergence
2.3. Horner's method
2.4. Newton- Raphson method and its convergence
2.5. Secant method and its convergence
2.6. Evaluation of polynomials using Horner's Rule

3. Curve Fitting **(8 hrs)**

3.1 Interpolation
- 3.1.1 Linear interpolation
- 3.1.2 Lagrange interpolation
- 3.1.3 Newton interpolation
- 3.1.4 Newton Divided Different interpolation
- 3.1.5 Spine interpolation: cubic spines
- 3.1.6 Control Interpolation (Gauss Forward/ Backward Formulae)

3.2. Regression
- 3.2.1 Least squares Regression

- 3.2.2 Fitting Transcendental Equations.
- 3.2.3 Fitting a polynomial function

4. Numerical Different & integration (7 hrs)

- 4.1 Differentiating continuous function
  - 4.1.1 Forward Difference Quotient
  - 4.1.2 Backward Difference Quotient
  - 4.1.3 Central Difference quotient
- 4.2 Newton cotes methods of integration
  - 4.2.1 Trapezoidal rule and composite trapezoidal rule
  - 4.2.2 Simpson's 1/3 rule & its composite
  - 4.2.3 Simpson's 3/8 rule.
  - 4.2.4 Boole 's Rule
- 4.3 Romberg integration
- 4.4 4.4. Gaussian integration

5. Linear Algebraic Equations (10 hrs)

- 5.1 Elimination Approach
  - 5.1.1 Basic Gauss Elimination
  - 5.1.2 Gauss Elimination with partial pivoting
  - 5.1.3 Gauss Jordon method
  - 5.1.4 LU decomposition methods
    - 5.1.4.1 Do Little Algorithm
    - 5.1.4.2 Crout Algorithm
  - 5.1.5 Matrix Inversion Method
  - 5.1.6 Cholesky Method
- 5.2 Iterative method
  - 5.2.1 Iconic method
  - 5.2.2 Gauss- seidal method
  - 5.2.3 Eigen values and eigen vectors using power method & inverse power method

6. Solution of ordinary differential equations (6 hrs)

- 6.1 Euler's method .
- 6.2 Heun's method (predictor – Corrector method)
- 6.3 Fourth order Runge-kutta method
- 6.4 Systems of differential equations using Heun's method
- 6.5 Higher order differential equations using Heun's method

7. Solutions of partial differential equations (3 hrs)

- 7.1 Elliptic equations
  - 7.1.1 Poisson's equations
  - 7.1.2 Laplace's equations
- 7.2 Parabolic Equations
- 7.3 Hyperbolic Equations

Laboratories:

1. Review of essential features of programming language
2. Bisection method
3. Newton-Raphson method
4. Secant method & Horner's rule
5. Lagrange interpolation
6. Linear Regression
7. Basic Gauss elimination method
8. Gauss Seidal method

9. Matrix inversion method
10. Trapezoidal rule
11. Simpson's 1/3 rule
12. Simpson's 3/8 rule
13. Solution of differential equation using Euler's method
14. Solution of differential equation using Runge-Kutta method
15. Spine Interpolation

References

1. E. Balagurusamy " Numencal Methods ' Tatal Mc Graw Hill
2. S.Yakwitz and F. szidarouszky '' An Introduction to Numerical Computations "2nd Edition Macmillan Publishing co ', New York .
3. W. Cdhency and D kixaid " Numerical Mathematics 4 computing "2nd Editior, Brooks /Cole publishing
4. C.F Gerald and P.o. Wheatley " Applied Numerical Analysis "4th Editim Addipon wesley publishing co. New york .
5. W. It presss, B p. Flannery et . al "Numerical Recises Inc", 1st Edition, Cambridge press 1988

Chapter	Marks Distribution
Chapter 1	5
Chapter 2	10
Chapter 3	10
Chapter 4	10
Chapter 5	12
Chapter 6	8
Chapter 7	5

Note: There might be minor deviation in mark distribution.

Detailed Syllabus of Numerical Methods

Note: Define(D), Description(Des), Derive (DR), Design(DSG), Illustration (I), Algorithm(Alg), Application (A), Experiment[Program (P)/Hardware(H)], Numerical (N)

Ch No.	Topic		Sub-Topic	Depth								Hour	Remarks
				D	Des	DR/DSG	I	Alg	H/P	A	N		
1	Introduction	1.1	Numerical computing process	D	Des							3 hrs	
		1.2	New trends in Numerical Computing	D	Des								
		1.3	Application in Numerical Computing	D						A			
		1.4	Errors in numerical methods: True Error, True Relative Error, Estimated Relative Error	D	Des								
2	Solution of non – Linear equation	2.1	Iterative methods and stopping criteria	D	Des							8 hrs	
		2.2	Bisection method & its Convergence					Alg	P		N		
		2.3	Horner's method								N		
		2.4	Newton- Raphson method and its convergence					Alg	P		N		

		2.5	Secant method and its convergence		**Des**						**N**		
		2.6	Evaluation of polynomials using Horner's Rule		**Des**						**N**		
3	**Curve Fitting:** **3.1 Interpolation** **3.2 Regression**	3.1.1	Linear interpolation	**D**	**Des**			Alg	P		**N**	**8 hrs**	
		3.1.2	Lagrange interpolation	**D**				Alg	P		**N**		
		3.1.3	Newton interpolation	**D**				Alg	P		**N**		
		3.1.4	Newton Divided Different interpolation								N		
		3.1.5	Spline interpolation: cubic spines	**D**	**Des**			Alg	P		N		
		3.1.6	Control Interpolation (Gauss Forward/ Backward Formulae)	**D**							N		
		3.2.1	Least squares Regression	**D**				Alg	P		N		
		3.2.2	Fitting Transcendental Equations.		**Des**						N		
		3.2.3	Fitting a polynomial function		**Des**						N		
4	**Numerical Different & integration:**	4.1.1	Forward Difference Quotient		**Des**						N	**7 hrs**	

	4.1 Differentiating continuous function **4.2** Newton cotes methods of integration **4.3** Romberg integration **4.4** Gaussian integration	4.1.2	Backward Difference Quotient		**Des**						N		
		4.1.3	Central Difference quotient		Des						N		
		4.2.1	Trapezoidal rule and composite trapezoidal rule		Des			Alg	P		N		
		4.2.2	Simpson's 1/3 rule & its composite	**D**	Des			Alg	P		N		
		4.2.3	Simpson's 3/8 rule.	**D**	Des			Alg	P		N		
		4.2.4	Boole 's Rule	**D**	Des						N		
		4.3	Romberg integration	**D**	Des						N		
		4.4	Gaussian integration	**D**							N		
5	**Linear Algebraic Equations:** **5.1** Elimination Approach **5.2** Iterative method	**5.1.1**	Basic Gauss Elimination		Des			Alg	P		N	**10 hrs**	
		5.1.2	Gauss Elimination with partial pivoting		Des						N		
		5.1.3	Gauss Jordon method		Des			Alg			N		
		5.1.4	LU decomposition methods: ▪ Do Little Algorithm ▪ Crout Algorithm		Des						N		
		5.1.5	Matrix Inversion Method		Des			Alg	P		N		

		5.1.6	Cholesky Method		Des						N		
		5.2.1	Gauss Jacobi		Des						N		
		5.2.2	Gauss- Seidal method		Des			Alg	P		N		
		5.2.3	Eigen values and eigen vectors using power method & inverse power method		Des			Alg	P		N		
6	**Solution of ordinary differential equations**	6.1	Euler's method		Des						N	**5 hrs**	
		6.2	Heun's method (predictor – Corrector method)		Des						N		
		6.3	Fourth order Runge-kutta method		Des			Alg	P		N		
		6.4	Systems of differential equations using Heun's method		**Des**						N		
		6.5	Higher order differential equations using Heun's method		**Des**						N		
7	**Solutions of partial differential equations:**	7.1.1	Elliptic equations ▪ Poisson's equations ▪ Laplace's equations	**D**	**Des**						N	**4 hrs.**	
		7.1.2	Parabolic Equations	**D**	**Des**						N		
		7.1.3	Hyperbolic Equations	**D**	**Des**						N		

PURBANCHAL UNIVERSITY

Model Questions Paper - 2023

PROGRAM: - BE Electrical/Electronics Communication& Automation Engineering

Semester: Fourth Semester

SUBJECT: - Python Programming FULL MARKS: - 60

TIME: - 03:00 hrs. PASS MARKS: - 24

Attempt all questions

Group A (very short question) [5*2=10]

1. Define characteristics equation.
2. Define least square regression.
3. What is numerical method?
4. Define linear interpolation.
5. Define true error with an example.

Group B (Long Questions) Answer any five questions [5*10=50]

6. a. Find the roots of the equation x^2-2x-3=0 using Newton Raphson method correcting up to three decimal places. [5]

b. Show that the convergence of Bisection method is linear. [5]

7. Solve the system given below using Gauss Jacobi Iteration Method:

8x+3y+4z=5

3x+10y+5z=6

4x+5y+16z=7 [10]

8. Fit a curve $y=ae^{bx}$ to the following data: [10]

X	5.01	10.00	15.05	25.10
Y	40.1	45.2	60.3	70.3

9. a) Estimate the following integrals using Simpson's 1/3 Rule:

$$\int_1^2 \frac{e^x}{x}\, dx$$

taking n=4 [5]

b) Estimate the integral using Gauss Quadrature with n=2

$$\int_0^1 \frac{1}{1+x^2}\, dx$$

[5]

10.Solve the initial value problem y'=2x+3y, y(0)=1 at x=0.2 using Runge Kutta fourth order method taking h=0.1 [10]

11. Solve the Laplace equation: uxx + uyy=0 in the region 0<x,1, 0<y<1 where u(0,y)=10, u(x,0)=20, u(1,y)=25, u(1,x)=30.

Take h=1/3 as shown in the figure below: