12242101: Numerical Techniques

Category	Title	Code	Credit-3			Theory Paper
BSC	**Numerical Techniques**	**12242101**	L	T	P	Major Evaluation: 30 marks
			3	-	-	Duration: 2 Hr

Objective of the Course:

- To perceive the Errors, Algebraic & Transcendental
- To expose the concept of Interpolation, Extrapolation, Numerical differential and Integration
- To understand Numerical solution of Ordinary Differential Equation
- To explore the Finite Difference Methods

Syllabus

Unit-1: Solution to algebraic and transcendental equation:

Introduction to significant digits and errors, truncation and round off error Solutions of non-linear equations in single variable using Bisection, Regula-Falsi and Newton-Raphson methods, convergence criteria

Unit-2: Solution to system of equations:

Gauss elimination methods, Gauss Jordan method, LU-Decomposition method, Gauss Jacobi and Gauss Seidel method, Condition for system and stability issues.

Unit-3: Interpolation and Numerical differentiation

Finite difference operators, difference tables, Newton's Forward/Backward difference, Central difference formula's, divided differences, Lagrange interpolation and Newton's divided difference method

Unit-4: Numerical Integration and solution to ODE

Numerical integration: Trapezoidal and Simpson's $1/3^{rd}$ & $3/8^{th}$ rules for integration Solution of first order and second order ordinary differential equations: Euler method, Euler modified method, Runge-Kutta methods

Unit-5: Solution to partial differential equation

Finite difference method, Solution to partial differential equation using variable separable method, One-dimension heat equation, Laplace equation and wave equation

Course Outcomes: After successful completion of this course students will be able to:

- CO1. Identify the concepts Algebraic & Transcendental Equations.
- CO2. Acquire the knowledge of finite difference
- CO3. Describe numerical integration and differentiation.
- CO4. Illustrate the problems of ordinary differential equation
- CO5. Analyze the Partial differential equations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	1	1	1	1	1	3	3	3
CO2	3	2	3	3	3	2	1	1	1	1	1	3	3	3
CO3	3	3	3	3	3	2	1	1	1	1	1	3	3	3
CO4	3	3	3	3	3	2	2	1	1	1	1	3	3	3
CO5	3	3	3	3	3	2	2	1	1	1	1	3	3	3

Text & Reference Books:

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publisher, 43rdEdition, 2015.

2. B.V. Ramanna: Higher Engineering Mathematics, McGraw Hill,1stEdition, 2017.

3. S.S. Sastry: Introductory Methods of Numerical Analysis, PHI Learning Private Limited, 4th edition, 2007.

4. J. H. Mathews and K. D. Fink: Numerical Methods using MATLAB, PHI, 4th edition, 2007.

5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis, Pearson Education, 6th edition, 2006.

6. H. K. Dass: Advance Engineering Mathematics, S. Chand& Company, Publisher, 2018.

Syllabus III sem (2024 admitted batch)

12242102: Data Structures

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
DC	Data Structures	12242102	2	1	-	Major Evaluation: 30 marks Duration: 2 Hr

COURSE OBJECTIVES

- To familiar the students with the use of data structures as the foundational base for computer solutions to problems.
- To understand various techniques of searching and sorting.
- To understand basic concepts about stacks, queues, lists, trees and graphs.

Syllabus

Unit I

Introduction to Data Structures: Algorithms & their Characteristics, Asymptotic Notations and complexity analysis, **Array:** Representations of Array, Index to Address Translation,

Linked List: Introduction, Implementation of Linked List, Operations, and types.

Unit II

Stack: Concepts and implementation of Stacks, Operations on Stack, Applications of Stack - Conversion of Infix to Postfix Notation, Evaluation of Postfix Expression, Recursion.

Queue: Concepts and Implementation, Operations on Queues, Dequeue, Priority Queues, Circular Queues.

Unit III

Trees: Types, Terminology, Binary Tree -Representations, Traversal, Threaded Binary Tree, Binary Search Tree, Height Balanced Tree-AVL Tree.

Graph: Terminologies, Representation of Graphs- Sequential & Linked Representation, Graph Traversals- BFS, DFS, Spanning Trees.

Unit IV

Searching: Linear Search, Binary Search, Hashing and Collision Resolution Techniques; Sorting: Bubble Sort, Selection Sort, Insertion Sort.

Unit V

Introduction to Advanced Data Structures, Real-world Applications (Big Data, AI, Cloud Computing, etc.), Hashing for Large-Scale Systems, Graph-Based Data Structures in Industry, Introduction to Concurrent and Distributed Data Structures etc.

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1. analyze algorithms using asymptotic notations and perform operations on arrays and linked lists.

CO2. construct stacks and queues and use them to solve real world problems.

CO3. distinguish between different types of trees and apply graph theory concepts.

CO4. compare various searching, sorting and hashing techniques.

CO5. discover the applications of data structure in emerging areas and real world.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1		1	1	1	1	2	1	
CO2	3	3	3	3	2	3	2	2	1	1	2	2		1
CO3	3	3	3	3	2	2		1	1	1	1	2	1	1
CO4	3	3	3	3	2	2		1	1	1	1	2		
CO5	3	3	3	3	2	3	2	2	1	1	2	2	1	1

RECOMMENDED BOOKS

- Data Structures, Algorithms and Applications in C++, Sartaj Sahni, 2nd Edition.
- An Introduction to Data Structures with Applications, Jean-Paul Tremblay, Mcgraw hill.
- Data Structures & Algorithms, Aho, Hopcroft & Ullman, original edition, Pearson Publication.

12242103: Fluid Mechanics

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	Major Evaluation: 30 marks
Departmental Core	Fluid mechanics	12242103	2	1	-	Duration: 2 Hr

Course Objectives: To make the students understand:

1. Fundamentals of Fluid Mechanics, which is used in the applications of aerodynamics. Hydraulics, marine engineering, gas dynamics etc.

2. Fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.

3. About hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

4. Explore and Apply Recent Trends and Technologies in Fluid Mechanics

5. Develop Problem-Solving and Analytical Skills

Syllabus

Unit-1

Properties of fluid: Pressure, density, specific weight, viscosity, dynamic and kinematic viscosity Newton's law of viscosity and its applications.

Fluid Static: Pressure variation with depth, pressure measurement, pressure on immersed surface centre pressure, Buoyancy, flotation, stability of floating bodies.

Unit-2

Fluid Kinetics: One dimensional flow approximation, control volumes concept, continuity equation in 3-D, its differential and integral form, velocity and acceleration of fluid particle, stream line, path line. Rotation, vorticity and circulation. Stream function and velocity potential function. Flow net, Free and forced vortex flow.

Unit-3

Fluid Dynamics: Momentum theorem, Impulse momentum equation and its application, Euler's equation in 3-D, Bernoulli's equation for incompressible fluid flow, engineering applications of energy equation, Pitot-Tube, Venturi meter. Orifice meter.

Unit-4

Flow through Pipes: Critical Reynolds's number, velocity distribution in pipes, friction factor, Laminar flow through pipe, Hagen-Poiseulli's equation, Turbulent flow through pipe, Hydraulic gradient line and total energy line. Minor head losses in pipes, Transmission of power through pipes.

Unit-5

Recent Trends and Technologies in Fluid Mechanics: Computational Fluid Dynamics (CFD): Introduction, tools (ANSYS Fluent, Open FOAM), applications, Microfluidics and Nano fluidics: Applications in medical devices, lab-on-a-chip Smart Fluids and Non-Newtonian Fluids: Magneto-rheological and electro-rheological fluids Renewable Energy Applications: Wind and hydro turbine fluid dynamics.

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1. Apply the fundamental concepts of fluid properties and fluid statics to solve basic engineering problems.

CO2. Analyze fluid motion using the principles of one-dimensional flow, control volume approach, and differential equations.

CO3. Apply fundamental fluid dynamics principles, including momentum and energy equations, to analyze incompressible flow and solve engineering problems

CO4. Analyze laminar and turbulent flow through pipes using Reynolds number, friction factor, and energy concepts, and evaluate head losses and power transmission in pipe systems.

CO5. Demonstrate an understanding of computational tools and advanced fluid types to analyze fluid behavior in engineering systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	1	1	1	2	1	-	3	-	-
CO2	3	3	1	2	3	1	1	1	1	1	-	3	-	-
CO3	3	3	3	3	2	2	1	1	1	1	1	3	-	-
CO4	3	3	3	3	3	2	2	2	2	1	1	3	1	1
CO5	3	3	3	3	3	2	1	2	1	1	1	3	1	2

Textbooks (Core References)

1. Yunus A. Cengel & John M. Cimbala, *Fluid Mechanics: Fundamentals and Applications*, McGraw-Hill Education
2. R. K. Bansal, *A Textbook of Fluid Mechanics and Hydraulic Machines*, Laxmi Publications
3. Som, Biswas, & Chakraborty, *Introduction to Fluid Mechanics and Fluid Machines* Tata McGraw-Hill
4. H. Versteeg & W. Malalasekera, *An Introduction to Computational Fluid Dynamics: The Finite Volume Method*, Pearson Education
5. Anderson, John D. , *Computational Fluid Dynamics: The Basics with Applications* McGraw-Hill Education
6. Ghosh, Ambarish, *Microfluidics and Nanofluidics: Theory and Selected Applications* Springer

12242104: Mechanics of Materials

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Mechanics of Materials	12242103	2	1	-	Major Evaluation Marks-30 Duration-2 hrs.

Course Pre-Requisites:
Engineering Mechanics

Course Objectives: To make the students:
1. Learn the basic concepts and principles of strength of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Apply the knowledge of strength of materials on engineering applications and design problems.

Syllabus

Unit-I
Simple Stress: Types of stresses, elongation of a bar, principal of superposition of forces, elastic constants, thermal stresses.
Compound Stress: Estimation of stresses on an inclined plane by analytical and graphical method (Mohr's circle method) for plane stress and plane strain, Principal stresses.

Unit-II
Shear Force and Bending Moment: Types of supports and beams, types of loading on beams, cantilever beams, simply supported beams.
Slope and Deflection: Equation of elastic curve, Macaulay's method, area moment method.

Unit-III
Torsion of Shaft: Torsion of circular shaft, power transmission, series and parallel combination of shafts. **Shear Stress in Beams:** Variation of shear stress, shear stress distribution in rectangular, circular, triangular and I-sections.

Unit-IV
Column and Struts: Euler's theory of column, equivalent length, Rankine's formula, slenderness ratio; strut with eccentric load.
Thin cylinder: Stress and strain in thin cylinder, wire wound thin cylinder.

Unit-V
AI and ML Based Failure Analysis:
Sensors: Vibration, temperature, pressure, force, and proximity sensors, along with NDI sensors, are used to collect data for analyzing material integrity and predicting potential failures. Procedure of failure analysis: data collection, pattern recognition, predictive modeling, proactive maintenance, benefits of AI based failure analysis. Case studies of bridges, aircraft, and critical infrastructure.

Course Outcomes:

Course Outcomes: After successful completion of this course students will be able to:

CO1. State the fundamental relationship between types of stresses and strains.

CO2. Discuss shear force and bending moment diagrams of the beams.

CO3. Compare the torsion of shaft and shear stresses in the beams.
CO4. Determine the buckling of column and struts.
CO5. Analyze the failure analysis on the basis of AI and ML.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	2	1	2	1	-	1	1	2	1	2
CO2	3	1	2	2	3	1	1	2	3	1	-	3	1	1
CO3	3	3	3	2	3	2	-	1	-	2	2	3	1	2
CO4	3	3	2	2	3	1	2	1	-	2	2	3	1	1
CO5	3	3	3	3	3	2	1	2	1	1	2	3	1	2

1-Slightly; 2-Moderately; 3-Substantially

Text & Reference Books

- Strength of Materials (MoM) by R S Khurmi
- Strength of Materials by S S Rattan; McGraw Hill Pub.
- Mechanics of Materials by F P Beer, E R Johnston, J T DeWolf; TATA McGraw Hill Pub.
- Strength of Materials by S. Timoshenko; D Van Nostrand Company
- Mechanics of Solids by Mubeen; Pearson Education Pub
- Strength of Materials by S Ramamrurtham, R Narayan; Dhanpat Rai sons Pub.
- Artificial Intelligence: A Modern Approach by Russell & Norvik, Pearson, 2003.
- Principles of AI - Nilsson
- Machinery Condition Monitoring: Principles and Practices, Amiya Ranjan Mohanty, 2014

NPTEL Link for Mechanics of Materials: https://onlinecourses.nptel.ac.in/noc18_ce04/preview

12242105: Industrial Engineering

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Industrial Engineering	12242105	2	1	-	Major Evaluation: 30 marks Duration: 2 Hr.

Course Objectives: To make the students to:

1. Understand fundamental concepts and tools used in production planning and control systems.
2. Develop the ability to analyze demand forecasting, scheduling, inventory models, and layout strategies.
3. Promote understanding of sustainability, automation, and continuous improvement in production systems.

Course Pre-Requisites: Basic Manufacturing Processes, Engineering Mathematics

Syllabus

UNIT-I Production Planning and Control: Needs of Production Planning and control, objectives of PPC, Principles of PPC, Functioning of PPC, Factor determining the PPC and Elements of PPC.

Demand Forecasting: Introduction, demand patterns, Need and classification of forecasting techniques, factors affecting forecasting, time series analysis, Least Square Method of Forecasting, Moving Average Forecasting, Exponential Smoothing, Regression and Forecasting Error.

Aggregate Planning: Introduction to Aggregate Planning, Factors affecting aggregate planning, objectives and aggregate planning strategies, aggregate planning methods.

UNIT-II Inventory Control: Meaning and types of inventories, objectives, and functions, need and classifications, inventory control terminology, inventory costs, Inventory models, quantity discount, An Inventory Model with Planned Shortages. Material Requirement Planning and Manufacturing Resource Planning (MRP-II)

UNIT-III

Production Scheduling and control: concept of single machine scheduling. Production control outline, Gantt chart, n jobs and 2 machine problems, n jobs and 3 machine problems, Johnson's algorithm, scheduling strategies,

Facility Locations, Plant Layout: Facility location factors and evaluation of alternate locations; qualitative aspects, quantitative models for layout decisions, types of plant layout and their evaluation.

UNIT-IV Linear Programming - problem formulation, simplex method, duality and sensitivity analysis; Transportation and assignment models

Unit-V Recent Industrial Engineering Tools: Engineering Economy and Costing, Lean Manufacturing and Six Sigma principles, Industry 5.0: IoT, Big Data, Smart Manufacturing, Digital Twins and Cyber-Physical Systems in production, Sustainability and green manufacturing practices.

Course Outcomes:

After successful completion of this course students will be able to:

CO1. **Analyze** different demand patterns and forecasting methods.

CO2. **Evaluate** inventory control methods

CO3. **Evaluate** facility location alternatives using quantitative and qualitative methods.

CO4. **Analyze** transportation and assignment problems for cost minimization.

CO5. **Analyze** the impact of Industry 4.0 technologies such as IoT and Big Data on production systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	2	1	3	2	2	3	3	3	2
CO 2	3	3	3	3	3		1	1	2	2	3	3	3	2
CO 3	3	3	3	3	3	2	1	1	3	2	3	3	3	2
CO 4	3	3	3	3	3	1	1	1	3	2	3	3	3	2
CO 5	3	3	3	3	3		3	1	3	2	3	3	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Text & Reference Books

1. Industrial Engineering and Production Management By Martand T. Telsang Publisher: S. Chand.

2. Production and Operations Management By R. Panneerselvam Publisher: PHI Learning.

3. Industrial Engineering and Management By O. P. Khanna Publisher: Dhanpat Rai Publications

4. Manufacturing Planning and Control for Supply Chain Management By F. Robert Jacobs, William Lee Berry, D. Clay Whybark, and Thomas E. Vollmann Publisher: McGraw-Hill

5. Operations Management" By Jay Heizer, Barry Render, and Chuck Munson Publisher: Pearson Education

NPTEL LINK FOR INDUSTRIAL ENFINEERING

https://nptel.ac.in/courses/112107238

12242111: Cyber Security

Category	Title	Code	Credit-Grade			Theory Paper
			L	T	P	
MAC	Cyber Security	12242111	2	-	-	Major Evaluation: 30 marks Duration: 1.5 Hr

COURSE OBJECTIVES

- To introduce the basic concepts of cyber security.
- To make students aware of various types of cyber threats, vulnerabilities, security policies and cyber security tools.
- To build basic skills for protecting information systems.

Syllabus

Unit I

Introduction to Cyber Security: Overview of Cyber Security, Goals of Cyber Security (Confidentiality, Integrity, Availability), Types of cyber-attacks: Phishing, Malware, Ransomware, Social Engineering, Malicious Software's. Hacker and its types. Real-world incidents and their impact, Cyber Ethics and Legal Aspects.

Unit II

Basics of Networking: Internetworking devices, Topologies OSI and TCP/IP models, IP address, DNS, TCP, IP, HTTP, HTTPS, Web Browser, Web Server.

Unit III

Security Mechanisms: Firewalls, Anti-virus, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS), Encryption and Decryption: Symmetric and Asymmetric, Cryptanalysis, Digital Signature, Authentication: Passwords, Biometrics, Multi-Factor Authentication.

Unit IV

System and Application Security: Operating System security basics. Securing mobile devices and apps. Web application vulnerabilities: SQL Injection, XSS, CSRF. Secure coding practices.

Cybercrime, Forensics, and Incident Response: Types of cybercrimes: Identity Theft, Financial Fraud, Cyberbullying. Basics of digital forensics. Cyber law and IT Act (India) overview. Incident response lifecycle and reporting.

Unit V

Cyber Threats in Mechanical Systems: Attacks on Industrial Control Systems (ICS), Security in Additive Manufacturing (3D printing) Case Studies: cyber-attacks on manufacturing sectors, Safe browsing, regular updates, backups. Strong password creation and management.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 Describe fundamental concepts of cyber security and identify common cyber threats and legal implications.

CO2 Explain basic networking concepts.

CO3 Demonstrate common security mechanisms used to protect digital data.

CO4 Analyze cybercrime scenarios and vulnerabilities in systems, and outline procedures for incident response and digital forensics.

CO5 Apply cyber security best practices to protect mechanical engineering systems such as Industrial Control Systems (ICS) , Additive Manufacturing technologies.

CO-PO Mapping Matrix												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2	1	2		3		2		2
CO2	3	2			2							1
CO3	3	2	2		3	1	1					2
CO4	3	3		3	3	2	1	2		1		2
CO5	2	1		2	2	3	2	3	2	2	1	3

RECOMMENDED BOOKS

1. "Cybersecurity for Beginners" by Raef Meeuwisse – Wiley
2. "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives" by Nina Godbole and Sunit Belapure – Wiley India
3. "Computer Security: Principles and Practice" by William Stallings and Lawrie Brown – Pearson
4. "Introduction to Cyber Security" by Chwan-Hwa (John) Wu and J. David Irwin – CRC Press
5. "Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short – Wiley.