



राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
National Institute of Technology Raipur
(Institute of National Importance)
G. E Road, Raipur-492010., (C.G.)

Phone: (0771) 2254200
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Basic Structure of the 4 years B. Tech. Mechanical Engineering Program

Courses For Semester-III (Year 2)

National Institute of Technology Raipur (C.G.)													
Course of Study and Scheme of Examination								B. Tech. III Semester					
S.No.	Board of Studies	Sub.Code	Subject Name	Periods/week			Examination Scheme					Total Marks	Credit L+(T+P)
				L	T	P	TA	FE	SE	T.C.A.	ESE		
1	Mech.Engg	ME 0501	Computer Graphics	3	1		20	15	15	50	70	120	4
2	Mech.Engg	ME 0502	Finite Element Method	3	1		20	15	15	50	70	120	4
3	Mech.Engg	ME 0503	Fluid Machinery	3	1		20	15	15	50	70	120	4
4	Mech.Engg	ME 0504	Manufacturing Science-II	3	1		20	15	15	50	70	120	4
5	Mech.Engg	ME 0505	Industrial Engineering	3	1		20	15	15	50	70	120	4
6	Mech.Engg	ME 0506	Machine Design-I	4	1		20	15	15	50	70	120	5
7	Mech.Engg	ME 0507	Computer Graphics Lab			3	30			30	20	50	2
8	Mech.Engg	ME 0508	Fluid Machinery Lab			3	30			30	20	50	2
9	Mech.Engg	ME 0509	Industrial Engineering Lab			3	30			30	20	50	2
10	Humanities	HUM 20524(ME)	Managerial Skill			2	25			25	0	25	1
11		ME 20525(ME)	Technical Visit/Practical Training				25			25	0	25	1
			Total	19	6	11	260	90	90	440	480	920	33

* TA- Teachers Assessment, FE- First Exam, SE- Second Exam, T. C. A- Total Continuous Assessment

Note: For attendance of a student in every theory and practical class, the teachers are supposed to keep records ultimately in the following format which will be included in the semester mark-sheets.

Format for attendance			
Attendance			Category
>85	→	'G'	Good
>70 & <85	→	'F'	Fair
>60 & <70	→	'S'	Satisfactory
<60 & >45	→	'P'	Poor
<45	→	'V'	Very Poor



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DEPARTMENT OF MECHANICAL ENGINEERING
COURSE OUTLINE

Subject: Computer Graphics

Subject Code	ME 0501		
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1+0	Credits	4
Prerequisite	Basics of C language		

COURSE OUTCOME

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

1. Apply and modify the different line drawing techniques.
2. Develop different curve drawing algorithms.
3. Apply transformations of different shapes in 2D and 3D.
4. Identify the concepts of projection systems (Parallel and perspective).
5. Assess different coordinate systems and apply the concept of clipping.

SYLLABUS

UNIT -1

Display device: Refresh Cathode ray Tubes, Random Scan and Raster Scan monitors, Colour CRT Monitors, Direct view Storage Tubes, Continuous Refresh and Storage display, LED and LCD Monitors.

Graphic primitives: Points & Lines, Line drawing Algorithm, DDA and Bresenham's Algorithm.

UNIT -2

Attributes of primitives: Line style, Type, Width, Colour, Character Attributes, Area Filling, and Antialiasing.

Fill Algorithm: Scan-Line Polygon Fill algorithm, Boundary Fill Algorithm, Flood Fill Algorithm, Seed fill algorithm.

UNIT -3

Analytical & Synthetic curve: C0, C1 and C2 Continuity, Convex hull, Parametric and non-parametric representation of curves. Analytic curves: Circle, Ellipse, Parabola, Hyperbola, Splines: linear, quadratic, cubic, hermite, Bezier curves, Synthetic Curves: circle and ellipse drawing, Parametric and Bresenham's algorithm.

UNIT -4

2D Transformation: Basic transformation-Translation, Scaling, Rotation, Reflection, Twist, Matrix Representation, Composite Transformations. 3D Transformation: Basic Transformations, 3D Display parallel & perspective projection.



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UNIT -5

Viewing: Viewing world co-ordination system, Normalized co-ordinate system, Device/Image co-ordination system, Window definitions, View port definitions, Viewing transformation.

Clipping: Point clipping, Line clipping, Cohen- Sutherland clipping, Midpoint clipping method, Sutherland and Hodgman Clipping.

Note: All the algorithms are to be practiced in the computer Programming Laboratory and practice any computer aided drafting software.

Text Books:

1. Computer Graphics-Donald Hearn and M. Pauline Baker-Prentice Hall of India Pvt Ltd.
2. Introduction to Computer Graphics – N. Krishnamurthy - TMH Publication.

Reference Books:

1. Computer Graphics –Harrington S. – TMH Publication.
2. CAD-CAM Theory and Practice-Ibrahim Zeid- TMH Publication.
3. Computer Graphics - Schaum's Outline –TMH Publication



Subject: Finite Element Method

Subject Code	ME 0502	Subject Code	ME 0502
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1+0	Credits	4
Prerequisite	Mathematics, Engineering Mechanics		

COURSE OUTCOME

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

1. Perceive and implement various steps involved in the Finite element Analysis (FEA).
2. Analyze 1D, 2D and 3D members using corresponding Finite elements (bar, plane and brick).
3. Develop the stiffness equation for common FEA elements, assemblage the local stiffness matrix into the global matrix.
4. Apply the local, geometric and natural boundary conditions and reduce the global structural equation in the solvable form.
5. Apply FEM tools to the areas of structural, thermal and fluid dynamics applications.

SYLLABUS

UNIT -I

Matrix algebra, the basic concept of FEM, spring and Bar elements, Element stiffness equation, Assembly stiffness equation by direct and inspection approach, Treatment of boundary conditions, Variational method of approximation (Rayleigh Ritz method, method of weighted residuals), potential energy formulation.

UNIT -II

Basic equation in elasticity, Stresses and strains, Compatibility equations, Strain-displacement relations, One dimensional problems, Linear, Quadratic and cubic elements, Shape functions, compatibility and convergence requirements, Co-ordinate system, Numerical Integration, Gauss Legendre quadrature, Application problems.

UNIT -III

Finite element analysis for plane stress and plane strain problem, Strain displacement matrix for 2-D elements, Co-ordinate transformation, global, local and natural co-ordinates, Two dimensional integrals. Application problems, scalar field problems including heat conduction and flow problems.

UNIT -IV

Stiffness matrix formulation for beam and frame element. Fem equations for plates and shell elements, axisymmetric solid elements, Applications and case studies of plates, shells and axisymmetric solids from structural and thermal viewpoint.

UNIT -V

Introduction of Dynamic analysis, Basic equations, Lagrange's equation, lumped and



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consistent mass matrices, Eigen-value problems and Eigen-modes.

Note: Solving case studies using user defined subroutines and FEA software – ANSYS and CAE Linux

Text Books

1. Fundamentals of finite Element Analysis by David Hutton.
2. Finite element in engineering by T. R. Chandrupatla and Belegundu

Reference Books

1. Concepts and applications of Finite element analysis by Cook, Malkus, Plesha and Witt.
2. The Finite element Method, A Practical course, Liu and Quek.
3. The Finite element Method in Engineering by S. S. Rao



Subject: Fluid Machinery

Subject Code	ME 0503		
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1+0	Credits	4
Prerequisite	Fluid Mechanics		

COURSE OUTCOME

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

1. Explain, identify and apply basic equations of fluid mechanics like law of conservation of mass, momentum and energy to solve the fluid flow problems.
2. Explain, analyze and design the fluid machinery elements like
 - I. Turbines (Impulse and Reaction)
 - II. Pumps: reciprocating and centrifugal.
 - III. Other fluid systems like hydraulic couplings etc.

SYLLABUS

UNIT – I

Impact of Free Jets: Impulse momentum principle, Force exerted by the jet on stationary flat and curved plate, hinged plate, moving plate and moving curve vanes, Jet propulsion of ship.

Flow around submerge bodies: Force exerted by flowing fluid on a body, drag and lift, stream lined and bluff body, drag on sphere and cylinder, circulation and lift on circular cylinder, lift of an air foil.

UNIT – II

Introduction to turbo machinery, Basic principles, Classification, Impulse and Reaction type, Fundamental equations, Euler's equation, Introduction to hydro-electric power plants, major components, Surge tanks etc. **Impulse Turbine:** Classification of turbine, Impulse turbine, Pelton wheel, Construction working, work done, Head efficiency and design aspects, governing of impulse turbine.

UNIT– III

Reaction Turbine: Radial flow reaction turbine, Francis turbine: construction, working, work done, efficiency, design aspect, advantages and disadvantages over pelton wheel.

Axial flow reaction turbine: Propeller and Kaplan turbine, Bulb or tubular turbine, Draft tube, Specific speed, Unit quantities, Cavitation, Degree of reaction, Performance characteristics, Surge tanks, Governing of reaction turbine.

UNIT-IV

Centrifugal Pumps: Classification of Pumps, Centrifugal pump, Construction, working, Work done, Heads, Efficiencies, Multistage centrifugal pump, Pump in series and parallel, Specific speed, Characteristic, Net positive suction head, Cavitation.



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UNIT – V

Reciprocating Pumps: Classification, Component and working, Single acting and double acting, Discharge, work done and power required, Coefficient of discharge, Indicator diagram, air vessels.

Fluid system: Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, Hydraulic crane, Hydraulic lift, Hydraulic Ram, Hydraulic coupling, Hydraulic torque converter, Air lift pump, Jet pump.

Text Books:

1. Mechanics of Fluid – Massey B. S. – English Language Book Society (U. K.)
2. Hydraulic Machines - Jagdish Lal – S. K. Kataria & Sons
3. Introduction to Fluid Mechanics and Fluid Machines – S. K. Som & G. Biswas - TMH

Reference Books:

1. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd.
2. Fluid Mechanics and Fluid Power Engineering – D. S. Kumar– Kataria & Sons
3. Hydraulics and Fluid Mechanics – Modi P. N, Seth S. M. – Standard Book House



Subject: Manufacturing Science-II

Subject Code	ME 0504		
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Compulsory	Contact Hours	44
L+T+P	3+1+0	Credits	4
Prerequisite	Manufacturing Science-1		

COURSE OUTCOME

At the end of the course the students are expected to be able to

1. Understand and identify various metal forming processes.
2. Understand the concept of machinability, thermal aspects in machining and cutting fluids and various locating and clamping elements like jigs and fixtures.
3. Understand and identify various surface finishing processes and manufacturing of gears.
4. Understand and identify different non-conventional machining processes.

SYLLABUS

UNIT – I

Forging: Principle, types, tools and fixture of forging, forging dies, forging machines, forging design, drop forging die design, upset forging die design, forging practice and process capability, forging defects, Inspection and testing of forged parts.

Extrusion: Principle, extrusion processes, process parameters, extrusion equipment, extrusion defects.

UNIT – II

Rolling: Principle, classification of rolled products, types of rolling, rolling mill train components, roll pass design for continuous mill.

Drawing: Wire drawing, tube drawing: Principle, setup, types.

Press Working: Types of presses, selection of press, components of a simple press, press working operations–shear, bending, drawing etc., types of dies, die sets, considerations in die design.

UNIT – III

Machinability: Concept and evaluation of Machinability, Mechanism of Tool failure, Tool wear mechanism, Tool life, Taylor's Tool life equation, Machinability index, factors affecting Machinability.

Thermal Aspects in Machining and Cutting Fluid: Source of heat in metal cutting and its distributions, temp measurement in metal cutting, function of cutting fluid, types of cutting fluid.

Jigs and Fixtures: Degree of freedom, principles of location and clamping, locating, clamping and indexing devices, principles of design, design of simple jigs and fixtures.

UNIT – IV

Grinding: Processes, machines, design consideration for grinding, specification of grinding



wheel, process parameters and economics of grinding.

Gear Cutting: Principle of gear generations, Gear manufacturing by casting processes, forming processes and Metal removal processes, gear cutting on milling machines (Forming and Generation). Gear finishing processes.

UNIT – V

Unconventional Machining: Advantages, application and limitation, mechanics of metal removal, specific application of following processes - EDM, ECM, USM, EBM and LBM.

Thread Rolling: Principle, Processes, Types of Thread Rolling, and Grinding, advantages and disadvantages.

Text Books:

1. Manufacturing Technology (Vol. - I & II) – P.N. Rao – Tata McGraw Hill Pub. Company, New Delhi
2. A Text Book of Production Technology (Manufacturing Processes & Technology) – P. C. Sharma – S. Chand and Company Ltd., New Delhi.

Reference Books:

1. Machine Tool Engineering – G. R. Nagpal – Khanna Publishers, New Delhi.
2. Production Technology – R.K. Jain – Khanna Publisher – New Delhi
3. Manufacturing Engineering and Technology – Serope Kalpakjian & Schmid – Pearson Education, Delhi.
4. Machine Tool Practices – Kibbe Richard R – PHI, New Delhi.
5. Principle of Metal Cutting – G. C. Sen, A. Bhattacharya – New Central Book Agency (P) Ltd. Calcutta
6. Manufacturing Processes (Vol-I&II) – H. S. Bawa- Tata McGraw Hill pub. Company, New Delhi



Subject: Industrial Engineering

Subject Code	ME 0505		
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Compulsory	Contact Periods/hours	52/44
L+T+P	3+1+0	Credits	4
Prerequisite	Nil		

COURSE OUTCOME-

Course is designed so that students will be able:

1. To understand the objective, function, contribution and place of industrial engineering.
2. To take the strategic decisions regarding location, site selection and plant layout for the industries.
3. To understand the basic concept of work study, method study, work measurement and able to take the decision for the industries.
4. To understand the importance of information technology as a new business tool for industries.
5. To recognize the need of trade union, reengineering, maintenance, replacement policies for the business organization.
6. To identify, Formulate, and solve the financial problems of the industries like depreciation, value analysis.

SYLLABUS

UNIT – I

Introduction: Definition of Industrial engineering, History & development, Objective of Industrial Engineering, Contribution of Industrial Engineering, Function of Industrial engineer, Place of Industrial engineering in an organization, Related discipline, Management, OR, Statistics, Ergonomics.

Plant Location, Site Selection and Plant Layout : Need for a suitable location, Urban, Suburban, Systems approach, Factors affecting location, Quantitative method for evaluation of plant location, Objectives & Principles of plant layout, Types of layout and their suitability, Software packages for layout analysis.

UNIT – II

Work Study: Productivity and work study, Introduction and definition of Work-study, Prerequisites of conducting a work study.

Method Study : Introduction, definition, procedure, Recording techniques, Flow Process Charts, Critical examination by questioning technique, man-machine chart, Motion economy principles, Micro motion study – Therbligs.

Work Measurement: Definition, Objectives, Techniques of Work measurement, Selection & timing the job, Rating, Allowances, Normal and standard time determination, Work sampling.



UNIT – III

Industrial Engineering and Information Technology : Role of IT/ IS in Industry, increasing value of Information Technology, IT as a New Business tool, IT as Business Enabler, IT as business driver, Internet worked enterprise, Internet, Intranet and Extranet, Globalization and IT, Competitative advantage with IT.

Business Process Re-Engineering: Definition, Need & characteristics, Industrial Engineering & Re- engineering, Framework for Reengineering, Process of Reengineering, Information Technology leverage in Reengineering, advantages of Re-engineering.

UNIT-IV

Forms of Business Organization: Types of Industrial Enterprise, Sole proprietorship, Partnership form, Joint stock company, Company's Act, The Capital and Shares, Private and Public Sector.

Trade Union: Meaning and Origin, Objectives of Trade Union, History of Trade Union in India, Laws related to Trade Union.

UNIT V

Maintenance Management: Objectives and need for maintenance, Types of maintenance, Breakdown, Predictive and Preventive Maintenance, Condition based maintenance system.

Equipment replacement policy: Reasons for replacement, Deterioration, Obsolescence, Depreciation, Methods for depreciation calculation.

Value Engineering & Value Analysis: Definition, Objectives & use of value analysis, Application & techniques.

Text Books:

1. Introduction to Work Study : International Labour Organization Geneva
2. Industrial Engineering and Production Management - Martand Telsang – S Chand & Company

Reference Books:

1. Industrial Engineering & Management –A new perspective, Philip E Hicks, Mcgraw Hill
2. Comprehensive Industrial Engineering- N. J. Manek --- Laxmi Publication (P) Ltd.
3. Industrial Engineering and Management Systems – S. Dalela, Mansoor Ali: Standard Publishing Distributors.



Subject: Machine Design-I

Subject Code	ME 0506		
Semester	V	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Compulsory	Contact Hours	55
L+T+P	4+1+0	Credits	5
Prerequisite	Engg Mechanics, Engg Graphics		

COURSE OUTCOME-

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

1. Apply the various stress based theories to design machine components
2. Select appropriate design data from Design data book.
3. Design basic machine elements like Keys, joints, coupling and shafts.
4. Design and select power transmission systems- belt and chain drives.
5. Design various types of joints-threaded, riveted and welded.
6. Design different types of power screws- lead screw, screw jack and power screw.

SYLLABUS

UNIT – I

General Considerations: Selection of Materials, Design Stress, Factor of Safety, Stress concentration factor in tension, bending and torsion, Theories of failures. Notch sensitivity, Design for variable and repeated loadings, Fatigue stress concentration factor, Endurance diagrams, Introduction to fracture mechanics.

UNIT – II

Basic Elements Design: Types of keys and Splines, Design of Socket-Spigot, Cotter joint, Sleeve and Cotter joint, Gib and Cotter joint, Design of Knuckle joint, Design of Splines.

Couplings: Types of couplings, Design of flange and flexible couplings, Compression coupling, Muff coupling.

Shaft and Axles: Transmission shaft, Design against static load, Design for strength, Rigidity and stiffness, Design under continuous loading for fatigue.

UNIT- III

Threaded fasteners: Geometry of thread forms, Terminology of screw threads and thread standards, Specifications of steel bolts, Initial tension, Relation between bolt tension and torque, Design of statically loaded tension joints, Design of bolted joints due to eccentric loading.

Power Screws: Power screws, Force analysis for square and trapezoidal threads, Collar friction, Stresses in screw, Coefficient of friction, Efficiency of thread, Design of power Screw.

UNIT – IV

Riveted Joints: Types of rivet heads, Types of riveted joints, Failure of riveted joint,



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Strength of rivet joint, Efficiency of riveted joint, Design of riveted joint, eccentrically loaded riveted joint.

Welded joint: Types of welded joints, Stresses in butt and fillet welds, Strength of welded joints, Location and dimension of weld design, Eccentrically loaded joint, Welded joint subjected to bending moment, Design procedure, Fillet welds under varying loads, Stress relieving techniques.

UNIT – V

Pulley & Flywheel: Flywheel Inertia, Stresses in Flywheel and pulleys, failure criterion.

Chain Drives: Chain drives, Roller chains, Geometric relationships, Dimensions of chain components, Polygonal effect, Power rating of roller chains, Selection of Chain drives.

Belt & Rope Drive: Design of Flat and Round belt drives, V-Belt, Timing belt, Wire Rope.

Text Books:

1. Machine Design by J. E. Shigley-McGraw Hill Publications.
2. Design of Machine Elements from V. B. Bhandari, TMH Publications.

Reference Books:

1. Machine Design – P. C. Sharma & D. K. Agrawal-Kataria & Sons Publications.
2. Principles of Mechanical Design - R. Phelan – McGraw Hill Pub.
3. Machine Design - An Integrated Approach Robert-L-Norton Published by Addison Wesley Longman (Singapore)
4. Machine Design – M. F. Spott – PHI
5. Machine Design, Theory & Practice – J. Michels Walter, E. Wilson Charles – Add MacMillan Publishers, New York.