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

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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**	**Credits L+(T+P)/2**
				L	T	P	TA	FE	SE	T.C.A.	ESE		
1	Mathematics	MA20311	Mathematics-II	3	1		20	15	15	50	70	**120**	4
2	Mech.Engg	ME 20312(ME)	Numerical Techniques	3	1		20	15	15	50	70	**120**	4
3	Mech.Engg	ME 20313(ME)	Material Science	3	1		20	15	15	50	70	**120**	4
4	Mech.Engg	ME 20314(ME)	Mechanics of Solids-I	3	1		20	15	15	50	70	**120**	4
5	Mech.Engg	ME 20315(ME)	Applied Thermodynamics	3	1		20	15	15	50	70	**120**	4
6	Mech.Engg	ME 20316(ME)	Machine Drawing	4	1		20	15	15	50	70	**120**	5
7	Mech.Engg	ME 20321(ME)	Numerical Techniques Lab			3	30			30	20	**50**	2
8	Mech.Engg	ME 20322(ME)	Material Testing Lab			3	30			30	20	**50**	2
9	Mech.Engg	ME 20323(ME)	Thermodynamics Lab			3	30			30	20	**50**	2
10	Humanities	HUM 20324(ME)	Value Education			2	25			25	0	**25**	1
11		ME 20325(ME)	Discipline				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: Mathematics

Subject Code	**MA 20311 (ME)**		
Semester	III	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 I & II		

COURSE OUTCOME-
At the end of the course the students will be able to

1. Explain the importance of Fourier series and apply the same for representing any function in series of Sine and Cosine functions.
2. Apply the concepts of Laplace transforms in solving complex problems by converting them into simple solvable form.
3. Illustrate mathematical models of solving partial differential equations involving more than one independent variable and apply the same in solving practical problems in the areas of epidemiology, traffic flow studies and the analysis of economics.
4. Relate the importance of complex integration and their rich application in determining the derivative and integrations of complex numbers.
5. Identify the need of studying certain special functions used in solving ordinary and partial differential equations which are employed in may physical phenomenon.

SYLLABUS

UNIT I - Fourier Series
Euler's Formula, Functions having points of discontinuity, Change of interval, Even and Odd functions, Half range series, Harmonic analysis.

UNIT II - Laplace Transform
Definition, Transform of elementary functions, Properties of Laplace transform, Transform of derivatives & integrals, Multiplication by t^n, Division by 't', Evaluation of integrals, Inverse Laplace Transform, Convolution theorem, Unit step function, Unit impulse function, Periodic function, Application to solution of ordinary differential equations.

UNIT III – Partial Differential Equation
Formation, Solution by direct integration method, Linear equation of first order, Homogeneous linear equation with constant coefficients, Non-homogeneous linear equations, Method of separation of variables.

UNIT IV– Complex Variables
Derivative, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Flow

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problem, Complex integration, Cauchy theorem, Cauchy integral formula, Taylor & Laurent series, Singularity, Residue, and Evaluation of real definite integrals.

UNIT V - Statistics

Random variables, Discrete and continuous probability distributions, Expectation, Mean and Standard Deviation, Moments and moment generating function, Distributions- Binomial, Poisson and Normal distributions.

Text Books:-

1. Higher Engg. Mathematics by Dr. B. S. Grewal– Khanna Publishers.
2. Advanced Engg. Mathematics by Erwin Kreysig – John Wiley & Sons.

Reference Books:-

1. Advanced Engg. Mathematics by R. K. Jain and S. R. K. Iyengar–Narosa Publishing House.
2. Applied Mathematics by P. N. Wartikar & J. N. Wartikar. Vol- II– Pune Vidyarthi Griha Prakashan, Pune.
3. Applied Mathematics for Engineers & Physicists by Louis A. Pipes TMH.

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Subject: Numerical Techniques

Subject Code	**ME 20312 (ME)**		
Semester	III	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 I& II		

COURSE OUTCOME:

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

1. Identify and apply a suitable method for solving the root of a transcendental equation.
2. Identify and apply different numerical methods for solve set of algebraic equations, system of linear and nonlinear equations.
3. Apply various methods for interpolation, curve fitting, differentiation, integration and methods for solving set of ordinary/partial differential equations.
4. Develop algorithm for numerical methods and thus apply the same for finding solutions to engineering problems.

SYLLABUS

UNIT I - Error Analysis and Roots of Equations

Approximation and Errors: Approximate number and significant Figures, Absolute, Relative and percentage error, Round of errors, truncated errors, accuracy of series approximations, Taylor's series, exponentials series, logarithmic series etc. Error propagation in functions of single and multiple variables.

Roots of Equations: Roots of algebraic, Transcendental and polynomial equation, Approximate roots, Real roots using bracketing methods, Bisection method and Regula-Falsi method, real roots using open method, Secant method, Iterative method, Complex roots of polynomial equations.

UNIT II - Solution of Coupled Equations

System of coupled equations, Unique solution, Singular solution, III conditional equations, Cramer's rule, Matrix method, Method of leading coefficients, gauss elimination– itfalls of elimination, Division by zero, Round off errors, Scaling effect, Gauss Jordan, Gauss Seidal, Convergence criteria of – Gauss, Newton Raphson's Method.

UNIT III - Curve Fitting

Interpolation: Difference Table, Interpolation, Newton's forward and backward interpolation, Newton's general interpolation formula, Lagrange's Interpolation, Gauss Central, Difference interpolation, Spline fitting–Cubic spline.

Regression: Regression Analysis, Least square analysis, Formation of Normal Equation, Linear Regression, Polynomial regression, Exponential Geometric and Trigonometric regression, Multiple regression.

UNIT IV - Numerical Differentiation

First, Second and Higher Order Differentiation Formula.

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Numerical Integration: Newton's Cotes Integration, Trapezoidal Rule, Simpson's one third and three eighth rule, Integration of equations, Romberg Integration, Gauss quadrature.
Solution of Ordinary Differential Equation: Euler's Method, Modified Euler's Method, Runge Kutta's Method Milene's Method.

UNIT V - Solutions of Partial Differential Equations by Finite Difference Technique
Finite difference method, partial Difference Equation: Elliptic, Parabolic and Hyperbolic Solution of Laplace and Poisson's equation by finite difference method, Iteration and relaxation techniques.

Computer Lab:
All methods are to be practiced using high level programming language such as FORTRAN, C, C++ or MAT Lab.

TEXT BOOKS

1. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale, McGraw Hill International Editions.
2. Numerical Methods in Engineering and Science by Dr. B. S. Grewal.

Reference Books:

1. Numerical Methods Analysis by J. Scarborough.

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Subject: Material Science

Subject Code	**ME 20313 (ME)**		
Semester	III	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	Nil		

COURSE OUTCOME:

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

1. Identify and differentiate the types of material crystal structure of solids, modes of metal and alloy solidification.
2. Analyse and identify the different modes of elastic and plastic deformations and their applications.
3. Identify and compare the significance of various phases of Fe-C diagram.
4. Judge the need of various heat treatment processes for engineering applications.

SYLLABUS

UNIT - I

Structure of Materials: Crystalline structure of solid: Concept of unit cell and space lattice, Miller Indices, Crystal structure determination by X-ray diffraction, Crystal imperfections.

Solidification of Metals and Alloys: Mechanism of solidification, nucleus formation and crystal growth, metal ingot structure-dendritic and columnar grains, grain boundaries, grain growth, effect of grain size on properties of metals, polytropic transformation.

UNIT – II

Elastic and Plastic Deformation: Material properties like strength, hardness, toughness, ductility, brittleness etc. and their importance in manufacturing. Quantitative evaluation of these properties with destructive testing methods. Mechanism of plastic deformation, role of dislocations, slip and twinning. Strain hardening, Seasons cracking, Bauschinger effect, yield point phenomena and related effects, Cold working and hot working processes, effect on properties like recovery, recrystallization, grain growth, grain size etc.

UNIT - III

Phase Diagrams: Phase and phase equilibrium: solidification of pure metals and alloys, Phase diagrams of monotectic, eutectic, eutectiod, peritectic and peritectoid & other systems. Allotropy of iron and Fe-C diagram.

UNIT – IV

Heat Treatment: Introduction, purpose of heat treatment, T-T-T curve and micro constituents in steel heat treatment processes like hardening, tempering, annealing, normalizing, Effects of heat treatment on properties of materials. Surface treatment processes.

UNIT - V

Engineering Materials: Classification, structure, general properties and applications of Cast Iron, Steel, brass, Bronze, bearing metals, light metal alloys, sintered carbide.

Text Books:

1. Engineering Physical Metallurgy – Lakhtin – CBS Publishers & Distributors
2. Materials Science- Narang – CBS Publishers & Distributors

Reference Books:

1. Elements of Material Science & Engg. - Van Vlack. – Addison – Wesley Longman, 6th Edn., New York.
2. Physical Metallurgy - Clark & Varney, East West Edn., New Delhi
3. Engineering Materials - Woulf series.
4. Material Science & Engg. – A first course – V. Raghavan – PHI (P) Ltd., Delhi, 2003
5. A Text Book of Material Science & Metallurgy – O.P. Khanna – Dhanpat Rai & Sons – New Delhi
6. Physical Metallurgy Principles – Robert E Reed Hill – Affiliated East-West Press Pvt. Ltd., New Delhi, 2004

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Subject: Mechanics of Solids-I

Subject Code	**ME 20314 (ME)**		
Semester	III	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	Engg Mechanics		

COURSE OUTCOME:

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

1. Apply mathematics to obtain analytical solutions in solid mechanics.
2. Visualize the concept of stress, strain, bending, torsion and the significance of principal stress and principal strain
3. Discover basic concepts of stress in solving problems involving combined bending and torsion stresses.
4. Develop appropriate models to formulate solutions.

SYLLABUS

UNIT - I Introduction

Basic of stress & strain, Elastic constant, Stress-strain diagram, Hooke's law, Stresses in the components subjected to multi-axial forces, Temperature stresses, statically indeterminate system.

UNIT – II Bending of beams

Bending of beams with symmetric section, boundary condition, Pure bending, Bending equation, traverse shear stress distribution in circular, hollow circular, I & T section.

UNIT - III Deflection of beam

Relation between slope deflection and radius of curvature, solution of beam deflection, problem by Macaulay's method, direct integration method, Method of super position, Moment Area Method.

UNIT -IV Torsion

Deformation in circular shaft due to torsion, Basic assumption, Torsion equation, Stresses in elastic range, Angular deflection, hollow and stepped circular shaft.
Spring: Closed and open coil helical spring subjected to axial load, spring in parallel & series.

UNIT - V

Principle stresses and strain
Transformation of plane stresses, Principle stresses, Maximum shear stresses, Mohr's circle for plane stresses, Plain strain and its Mohr's circle representation, Principle strains, Maximum shear strain. Combined Loading: Components subjected to bending, torsion & axial loads.

Text Books:

1. Elements of strength of material – Timoshenko & young- EWP press
2. Mechanics of Solids – Beer & Johnson, Tata McGraw Hill Publications.

Reference Books:

1. Strength of material – Rider–ELBS
2. Introduction to Solid Mechanics – I. H. Shames–PHI
3. Strength of Materials – R. K. Rajput – Dhanpat Rai & Sons
4. Strength of Materials – Dr. Sadhu Singh – Khanna publication

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Subject: Applied Thermodynamics

Subject Code	ME 20315 (ME)		
Semester	III	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	Physics, Basic Mechanical Engg		

COURSE OUTCOME:

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

1. Interpret the concept of entropy and irreversibility.
2. Summarize thermodynamic relationship between various properties.
3. Discuss vapor properties (i. e steam) and steam power plant cycles.
4. Distinguish reciprocating compressors and thermodynamics of compressible flow.

SYLLABUS

UNIT - I

Second Law Analysis

Introduction to the second law of Thermodynamics, The Clausius inequality, Entropy, Principle of increase in entropy, T-ds relation. Availability–Second law analysis of closed system, Second law analysis of steady–flow system, Irreversibility.

UNIT - II

Thermodynamic Relationships

Helmholtz and Gibbs functions, Coefficient of Volume expansion and isothermal compressibility, Differential relations of internal energy, Maxwell's Relation, C_p, C_v relations, T-ds equations, Clapreyon equation, Kelvin coefficient.

Equation of state:

Ideal gas equation of state, Real gas deviation with ideal gas, Vanderwaals equation, evaluation of its constants, Virial expansions, Limitations of the equation. The law of corresponding states.

UNIT – III

Vapour and Vapour Power Cycle

Properties and processes in ideal vapour, Use of steam tables and Molier's diagram in determination of steam properties, energy and entropy calculations. Carnot and Rankine cycle as applied to steam power plants, Reheat cycle, Ideal regenerative cycle, Practical regenerative cycle, Characteristics of ideal working fluids, Binary vapour cycle.

Unit – IV

Reciprocating Air Compressors

Classification of air compressors, Advantages, Disadvantages of reciprocating compressors, Working of reciprocating compressor, Equation of work (with and without clearance) volumetric efficiency, Multistage compressors, Efficiency of compressor, Effect of

atmospheric condition on output of Compressors, Thermodynamic analysis of reciprocating compressor, Intercooler and External cooler.

Unit – V

Thermodynamics of Compressible Fluids

Isentropic flow, Stagnation conditions, Stagnation enthalpy, Temperature, Pressure, Density, Flow through available area, Duct, Converging nozzle, Convergent divergent nozzle, Operation of convergent divergent nozzle for different back pressures. Flow with friction and heat transfer, Fanno flow, Rayleigh flow. Flow of steam through nozzle, Throat area for maximum discharge, Supersaturated Flow in nozzle.

Text Books:

1. Engineering Thermodynamics – P. K. Nag – TMH Publishers
2. Thermodynamics & Thermal Engineering–J. Selwin Rajadurai – New Age International Publishers

Reference Books:

1. Thermodynamics – C. P. Arora – TMH Pub.
2. Thermal Science & Engineering – D.S. Kumar – S. K. Kataria & Sons
3. Thermodynamics – S. C. Gupta – Pearson Education
4. Thermodynamics- An Engineering Approach – Cengal & Boles – McGraw Hill
5. Engineering Thermodynamics – K. Ramakrishna – Anuradha Agencies

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Subject: Machine Drawing

Subject Code	**ME 20316 (ME)**		
Semester	III	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. Graphics		

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

1. Describe conventional representation of machine elements, limit, fits, tolerances, and fasteners, welded and riveted joint.
2. Draw and identify different types of shaft couplings, bearings, pipe joints, pulleys and gears in mesh.
3. Understand and recognize the half section and full section views of various engineering components.
4. Understand and illustrate the detailed drawings of various engine parts and boiler mountings.
5. Apply their knowledge to read production drawing at the site.

SYLLABUS

UNIT - I
Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints.
Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts.
Fasteners: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts.
Riveted joints: Forms and proportions of river heads, Different views of different types of riveted Lap and Butt joints.

UNIT – II
Drawings of various views of
Shaft joints: Cotter joint and Knuckle joint. **Keys & Shaft coupling:** Muff, Flanged, Flexible, Universal and Oldham's coupling. **Shaft bearing:** Solid and bush bearing, Plummer block, Footstep bearing. **Pipe joint:** Flanged joint, Socket and Spigot joint, Hydraulic joint, Union joint, Gland & Stuffing Box, Expansion joint. **Pulley:** Belt pulley, V belt pulley, Fast and loose pulley, Speed cone pulley, Built up pulley.
Gears: Spur gear in mesh with approximate construction of tooth profile, Rack and pinion.

UNIT – III
Assembly and detailed drawings of Engine Parts: Piston, Stuffing box, cross head, vertical and horizontal engine, Connecting rod, Crank, Eccentric.

Valves: Steam stop valves, Feed check valve, Safety valves, Blow off cock.

NOTE– Study of assembly production drawing/blue print is to be practiced in the tutorial/practical. Few drawings are to be practiced on AutoCAD. The parts are to be shown during practice**.**

Text Books:

1. Machine drawing- N. D. Bhatt., published by R. C. Patel, Charotar Book Stall Tulshi Sadan, Station Road, Annad, India.
2. Machine drawing – P. S. Gill S. K. Kataria & Sons Delhi.
3. Machine drawing – T. Jones.