



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-IV (Year 2)

National Institute of Technology Raipur (C.G.)													
Course of Study and Scheme of Examination										B. Tech. IV 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	Mech.Engg	ME 20411(ME)	Internal Combustion Engine	3	1		20	15	15	50	70	120	4
2	Mech.Engg	ME 20412(ME)	Fluid Mechanics	3	1		20	15	15	50	70	120	4
3	Mech.Engg	ME 20413(ME)	Mechanics of Solids-II	3	1		20	15	15	50	70	120	4
4	Mech.Engg	ME 20414(ME)	Measurement & Control	3	1		20	15	15	50	70	120	4
5	Mech.Engg	ME 20415(ME)	Manufacturing Science-I	3	1		20	15	15	50	70	120	4
6	Mech.Engg	ME 20416(ME)	Kinematics of Machines	4	1		20	15	15	50	70	120	5
7	Mech.Engg	ME 20421(ME)	I. C. Engine Lab			3	30			30	20	50	2
8	Mech.Engg	ME 20422(ME)	Fluid Mechanics Lab			3	30			30	20	50	2
9	Mech.Engg	ME 20423(ME)	Manufacturing Practice/ Measurement Lab			3	30			30	20	50	2
10	Humanities	HUM 20424(ME)	Personality Development			2	25			25	0	25	1
11		ME 20425(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



DEPARTMENT OF MECHANICAL ENGINEERING
COURSE OUTLINE

Subject: Internal Combustion Engine

Subject Code	ME 20411 (ME)		
Semester	IV	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	Thermodynamics		

COURSE OUTCOME:

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

1. Understand the working of an I. C. Engines (i.e. S. I. and C. I. engine) and their applications.
2. Understand the combustion process in I. C engines and different type's fuels, their stoichiometric compositions.
3. Understand and identify various systems (ignition, injection, and cooling and lubrication system) of an I.C. Engine.
4. Understand and analyze the performance characteristics of an I. C engine and their emissions from of I. C. engines

SYLLABUS

UNIT - I

Introduction: Introduction of Internal and external combustion engine and their comparison, four stroke cycle S. I. and C. I. engine, Two stroke engine, Comparison of four stroke and two stroke engines, Comparison of S. I. and C. I. engine, Classification of I.C. engine, Valve timing diagram for S. I. and C. I. engines, Effect of valve timing and engine speed on volumetric efficiency, reasons for ignition and injection advance, Dual fuel, Multi-fuel and Wankel Rotary engine.

Cycles: Reasons for deviation of actual cycle from air standard cycles, Variation specific heats and cycle analysis, fuel air cycles and their analysis, Actual cycles and their analysis, Purpose and Thermodynamic cycle of supercharging.

UNIT - II

Fuels: Basic requirement of I.C. Engine fuels, Requirement of an ideal gasoline, Structure of petroleum, Effect of fuel structure on combustion, Volatility of liquid fuels, effect of volatility on engine performance for starting, Vapour lock, Acceleration, Percolation, Carburettor, icing and Crank case dilution.

Combustion: Determination of stoichiometric air fuel ratio, Fuel-air and exhaust gas analysis for a given combustion process. Combustion in S.I. and C.I. engines, Detonation, Pre-ignition, Knocking, Antiknock rating of fuels Octane number, Critical compression ratio, HUCR, performance number, Cetane number, Dopes.



UNIT – III

Carburettor: Properties of air-petrol mixtures, Mixture requirement, Simple carburettor, limitation of simple carburettor, Modern carburettor, Main metering system, Idling system, Economizer system, Acceleration pump and cold starting system. Nozzle lip, Venturi depression, Calculation of fuel jet and venturi throat dia for given air fuel ratio. Petrol Injection Electronic fuel injection, advantage and disadvantage of petrol injection, Multi point Fuel Injection System.

UNIT – IV

Ignition System: Battery and magneto ignition system and their comparative study, Spark plug heat range, Electronic ignition system, Firing order, Ignition timing, Centrifugal and vacuum ignition advance.

Injection System: Requirement, type, Fuel pump, Type of fuel injector, Type of nozzle, Atomization, Spray penetration and spray direction, Multiple point fuel injection system.

Cooling System: Cooling requirement, Air cooling, liquid cooling, Type of liquid cooling system, Advantage and disadvantage of air cooling and water cooling system, Antifreeze mixture.

Lubrication System: Function of lubricating system, Properties of lubricating oil, Wet sump, Dry sump and mist lubrication system.

Governing of I C Engine: Necessity of governing, various methods of governing.

UNIT – V

Testing and Performance: Performance parameters, Measurements of brake power, indicated power, Friction power, Fuel and air consumption, Exhaust gas calorimeter, Calculation of various performance parameter, Heat balance sheet. Performance current for S.I. and C.I. engine with load and speed.

Emission and Pollution: S. I. Engine and C. I. Engine emissions and its control and comparison. Effect of pollution on Human health and biosphere.

Text Books:-

1. A Course in Internal Combustion Engines – M. L. Mathur & R.P. Sharma – Dhanpat Rai & Sons
2. Internal Combustion Engine – V. Ganeshan – TMH

Reference Books:-

1. A Course in Internal Combustion Engine – V. M. Domkundwar – Dhanpat Rai & Sons
2. Internal Combustion Engine – R. Yadav – Central Publishing House, Allahabad
3. Fundamental of Internal Combustion Engine – Paul W. Gill, James H. Smith, Eugene J. Ziurys Oxford and IBH Publishing Company
Internal Combustion Engines – R. K. Rajput – Laxmi Publication



Subject: Fluid Mechanics

Subject Code	ME 20412 (ME)		
Semester	IV	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, Mathematics		

COURSE OUTCOME

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

1. Understand and apply mathematical principles for analyzing fluid flow problems using conservation of mass, momentum, and energy principles.
2. Apply mass, momentum, and energy balances to study fluid flow processes and engineering systems.
3. Differentiate various fluid flow problems, such as internal or external flow, depending on conditions or assumptions defined in engineering problems.
4. Analyze and apply various concepts of fluid statics and dynamics.
5. Analyze dimensionally different types of fluid flow formula through model analysis (Reynolds, Weber, Fraude's, Euler's and Mach numbers)
6. Understand and identify the boundary layer, flow control and flow separation.

SYLLABUS

UNIT - I

Properties of fluid: Fluid, ideal and real fluid, Properties of fluid: Mass density, Weight density, Specific volume, Specific gravity, Viscosity, Surface tension, Capillarity, Vapor pressure, Compressibility and bulk modulus. Newtonian and non-Newtonian fluids.

Fluid statics: Pressure, Pascal's law, Hydrostatic law, Pressure measurement, Hydrostatic force on submerged plane and curved surface, Buoyancy and Flotation, Liquid in relative equilibrium.

UNIT - II

Fluid kinematics: Description of fluid motion, Lagrangian and Eulerian approach, Type of fluid flow, Type of flow lines-path line, Streak line, Stream line, Stream tube, Continuity equation, Acceleration of a fluid particle, Motion of fluid particle along curved path, Normal and tangential acceleration, Rotational flow, Rotation and Vorticity, Circulation, Stream and potential function, Flow net, Its characteristics and utilities, Vortex motion.

UNIT – III

Fluid dynamics: Euler's Equation, Bernoulli's equation and its practical application, Venturimeter, Orifice meter, Nozzle, Pitot tube, Impulse momentum equation, Momentum of Momentum equation, Kinetic energy and Momentum correction factor.

UNIT – IV

Laminar & Turbulent flow: Reynold's experiment, Shear stress and pressure gradient relationship, Flow of viscous fluids in circular pipe and between two parallel plates, Couette



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flow, Shear stress & velocity distribution for turbulent.

Flow through pipes: Loss of energy in pipes, Hydraulic gradient and total energy line, pipe in series and parallel, Equivalent pipe power transmission through pipe, Water hammer in pipes.

UNIT – V

Internal flows: Friction factor, Darcy-Weisbach friction factor, Moody's diagram, Boundary Layer theory, Boundary layer equation, Laminar and turbulent boundary layer and its growth over flat plat. Momentum boundary layer and its solutions, separation of boundary layer and its control.

Dimensional analysis: Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem, Limitations, Model analysis, Dimensionless number and their significance, model laws, Reynolod's model law, Fraude's model law, Euler's model law, Weber's model law, Mach's Model law.

Text Books:-

1. Hydraulics and fluid Mechanics by Modi and Seth, 12th ed. 1998, Standard Book House, Delhi.
2. Fluid Mechanics and Hydraulic machines by R. K. Bansal, 8th ed. 2002, Laxmi publication (P) Ltd.
3. Fluid Mechanics & machinery – C. P. Kotharaman & R. Rudramoorthy New Age Pub.

Reference Books:-

1. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
2. Fluid Mechanics by V.L. Streeter & E.B. Wylie, 1st SI metric ed. 1981, McGraw Hill Book Company



Subject: Mechanics of Solids-II

Subject Code	ME 20413 (ME)		
Semester	IV	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, Mechanics of Solids - I		

COURSE OUTCOME

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

1. Visualize and apply mathematics to obtain analytical solutions in solid mechanics.
2. Interpret the principle of superposition, energy methods of determining the reaction and their applications for solving statically indeterminate structures.
3. Apply the basic concepts of stress and strain in dealing problems related to unsymmetrical bending, fixed beams, continuous beams, curved beams, thick and thin pressure vessels..
4. Discover principles of solid mechanics by solving engineering problems.
5. Develop appropriate models for practical situations to formulate solutions.

SYLLABUS

UNIT - I

Energy Methods: Introduction, Principles of superposition, Strain energy, Reciprocal relations, Maxwell Betti theorem, Elastic strain energy in tension and compression, Strain energy in beams subjected to bending and shafts to torsion. Impact loading in tension and bending, first and second theorem of Castigliano and its applications.

UNIT - II

Fixed Beams: Fixed beam subjected to different types of loads and couples, Calculations of fixing moments and reactions at supports, deflection. Effect of sinking of support.

Continuous beams: Continuous beams subjected to different type of loads and couples, beams with overhang, beams with one end fixed, Clapeyron's theorem. Effect of sinking of supports.

UNIT – III

Bending of curved bars: Stresses in bars of small initial curvature, Winkler-Bach theory, Stresses in bars of large initial curvature, Deflection of Crane hooks, Chain links, circular rings, stresses in circular rings.

UNIT – IV

Unsymmetrical Bending: Introduction to unsymmetrical bending, Stresses and deflection in unsymmetrical bending, Shear center for angle, Channel and I-sections.

Columns: Struts and Columns, Stability of columns, Euler's formula for different end conditions, Equivalent load, Eccentric loading, Rankine's formula.



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UNIT – V

Thin Pressure Vessel: Thin Pressure Vessels, Circumferential and longitudinal stresses in thin cylindrical shells and thin spherical shell under internal pressure,

Thick Pressure Vessel: Stresses in thick and compound cylinders.

Text Books:-

1. Advanced Mechanics of Materials–A. P. Boresi and O. M. Sidebottom–John Wiley & Sons
2. Strength of Materials – G.H. Rider – Macmillan
3. Mechanics of Material – J. M. Gere and S. P. Timoshenko – CBS publisher
4. Strength of Materials – R. K. Rajput – S. Chand & Company

Reference Books:-

1. Mechanics of Material – F. P. Beer and E. E. Johnston – McGraw Hill
2. Strength of Material, Vol. I and II – S. P. Timoshenko – EWP Press
3. Strength of Material – Dr. Sadhu Singh – Khanna Publishers



Subject: Measurement and Control

Subject Code	ME 20414 (ME)		
Semester	IV	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	Basic Electrical		

COURSE OUTCOME

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

1. To understand the characteristics, functioning and calibrations of various measuring instruments.
2. To interpret the use of instruments for measuring displacement, velocity, pressure and temperature.
3. To perceive the working of strain gauges and their use for measuring force and torque.
4. To demonstrate the use of instruments for measuring flow rate, noise and vibrations.
5. To illustrate the data acquisition system for enhancing the productivity
6. To understand the surface characteristics and their measurement using mechanical and optical instruments.

SYLLABUS

UNIT - I

Generalized Measurement System: Introduction - Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, Units of measurement, Static and dynamic performance characteristics of measurement devices, Calibration, Concept of error, Sources of error, Statistical analysis of errors sensors and Transducers– Types of sensors, Type of transducers and their characteristics.

UNIT - II

Measurement: Measurement of displacement and angular velocity. Measurement of pressure: Gravitational direct acting, Elastic and indirect type pressure transducers. Measurement of very low pressure–McLeod gauge and Pirani gauge. Measurement of temperature: Measurement of temperature by thermometers, Bimetallic, Thermocouples, Thermistors and pyrometers-total radiation and optical pyrometry, Thermocouples, RTDs, Pyrometers, Pyrometric Cones.

Measurement of Strain: Type of strain gauges and their working, Strain gauge circuits, McLeod gauge, Pirani gauge, Temperature compensation. Strain rosettes, Analysis of strains, Measurement of force and torque.

UNIT – III

Measurement of flow: Obstruction meters, Variable head meters, Hot wire and magnetic meters, Ultrasonic flow meters. Vibration and noise measurement: Seismic instruments, Vibration pickups and decibel meters.

Data acquisition system: Introduction to data acquisition systems, Single and multi



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channel systems, Microprocessors and PC based data acquisition systems. Input – output devices signal transmission and Processing, Devices and systems.

UNIT – IV

Metrology: Standards of measurement, Linear and angular measurement devices and systems limit gauges, Gauge blocks. Measurement of geometric forms like straightness, Flatness, Roundness and Circularity, principles and application of optical projectors, Tool makers, Microscope, Autocollimators etc. Principle and use of interferometers, Comparators, Measurement of screw threads and gears, Surface texture measurement.

UNIT – V

Control: Open Loop and Close Loop control, Transfer function, Stability Equations, Feed back systems.

Text Books:-

1. Measurement Systems, Application and Design – E.O. Doebelin - McGraw Hill
2. Mechanical Measurements and Control – D.S. Kumar – S.K. Kataria & Sons
3. Mechanical Measurements – G. Beckwith & Thomas G. – Pearson Education
4. Automatic Control Systems-Kuo

Reference Books:-

1. Engineering Metrology – K.J. Hume - MacDonald and Company
2. Engineering Metrology – I.C. Gupta - Dhanpat Rai & Sons
3. Mechanical & Industrial Measurements – R.K. Jain – Khanna Publishers



Subject: Manufacturing Science-I

Subject Code	ME 20415 (ME)		
Semester	IV	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	Workshop, Material Science		

COURSE OUTCOME

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

1. Identify various manufacturing processes and techniques for different industrial applications.
2. Analyze and identify various processes and steps involved in foundry practice.
3. Describe the principles of fabrication and metal joining processes such as brazing, soldering and welding.
4. Understand and identify the significance of metal cutting operations and signature of the single point and multipoint cutting tools.
5. Associate and identify the use of various machine tools for different manufacturing processes.

SYLLABUS

UNIT - I

Introduction to Manufacturing Processes: Importance of manufacturing processes, classification, economic and technological definitions of manufacturing processes.

Foundry Practice **Pattern making**- Types, material, allowances, core – types, materials and its properties. **Mould Making and Casting** - Types of sand moulding, design considerations, moulding machines and moulding procedure, moulding sand – types, properties, composition and applications. Casting defects. **Special Casting Processes:** Investment casting, centrifugal casting, shell moulding, CO₂ moulding, slush casting, die casting.

UNIT - II

Welding: Principles of Welding, survey and allied processes

Arc Welding: TIG and MIG processes and their parameter selection, atomic hydrogen welding, welding of cast iron, welding electrode – types, composition, specification.

Resistance Welding: Principle, equipment and processes. Thermit Welding, brazing & soldering, Internal and external welding defects, Inspection & testing of weld.

UNIT – III

Machine Tool Technology

Cutting Tool – Types, requirements, specification & application

Geometry of Single Point Cutting Tool – Tool angle, Tool angle specification system, ASA, ORS and NRS **Mechanics of Metal Cutting:** Theories of metal cutting, Chip formation, types of chips, chip breakers, Orthogonal and Oblique cutting, stress and strain in the chip, velocity relations, power and energy requirement in metal cutting.



UNIT – IV

Machine tool

Lathe: Introduction, type, specification, construction, work holding devices and tools, mechanism and attachments for various operations, taper turning, thread cutting operations, capston and turret lathe.

Shaper: Introduction, type, specification, Quick return Mechanisms, Table feed mechanism, work holding devices, shaper operations.

Slotter and Planner: Introduction, specification, types of drives, types of machines.

Milling Machine: Introduction, specification, types, mechanisms and attachments for milling, milling operations, Indexing-simple, compound and differential.

UNIT – V

Drilling: Introduction, drill nomenclature, types of drilling machines, other operations like counter boring, counter sinking, spot facing etc.

Reaming: Introduction, description of reamers, type of reaming operations.

Boring: Introduction, types of boring machines, boring operations, boring tools

Broaching: Introduction, types of broaches, nomenclature of broach, types of broaching machines.

Surface finishing operations: Honing, lapping, super finishing, polishing, buffing, process parameters and attainable grades of surface finish.

Text Books:-

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

Reference Books:-

1. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi
2. Manufacturing Engineering and Technology – S. Kalpakjian & S.R. Schmidt – Addison Wesley Longman, New Delhi
3. Production Technology – R.K. Jain – Khanna Publishers, New Delhi
4. A Text Book of Production Technology (Vol.I & II) – O.P. Khanna – Dhanpat Rai & Sons, New Delhi.
5. Shop Theory-James Anderson and Earl E Tatra, T Tata McGraw Hill, New Delhi.
Manufacturing Process (Vol-I&II)-H.S. Bawa-Tata McGraw Hill Pub. Company, New Delhi.



Subject: Kinematics of Machines

Subject Code	ME 20416 (ME)		
Semester	IV	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		

COURSE OUTCOME

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

1. Explain the difference between link, mechanism and machine.
2. Analyze the difference between higher and lower pairs, understand kinematics of mechanisms by drawing the velocity and the accelerations diagrams.
3. Analyze and design the basic machine elements like flywheel, governor, brakes and dynamometers.

SYLLABUS

UNIT - I

Relative velocity: Elements, pairs, Mechanism, Four bar chain and its inversion, Velocity diagrams, Relative velocity method, Instantaneous centre method.

UNIT-II

Relative Acceleration: Synthesis of mechanism, Pantograph, Lower pair mechanism, Relative acceleration diagram, Kliens construction, Coroillis component of acceleration.

UNIT-III

(a) Inertia force analysis: Effective force and inertia force on link, Inertia force on reciprocating engine. Inertia force in four bar chain mechanism.

(b) Turning moment diagram and flywheel: Turning moment diagram for single and multi cylinder internal combustion engine, Coefficient of fluctuation of speed. Coefficient of fluctuation of energy, Flywheel.

UNIT-IV

Governors: Characteristics of centrifugal governors, Gravity controlled governors, porter and proell. Spring controlled centrifugal governor: Hartung and hartnell governor. Performance parameter: Sensitivity, stability, Isochronism, Governor effort and power.

UNIT –V

(a) Friction: Friction in turning pair, Application of friction circle in slider crank and four mechanism, Pivot and collar friction, Thrust bearing.

(b) Brakes and dynamometer: Simple block and shoe brake, Band brake, Band and block brake, and internal expanding shoe brake, Absorption dynamometer, Transmission dynamometer.



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Text Books:

1. Theory of machine – S .S. Ratan-Tata McGraw Hill.
2. The Theory of machine – Thomas Beven – CBS Publishers.

Reference Books:

1. Theory of mechanism and machine – A. Ghosh, A. K. Mallik –EWP Press.
2. Theory of Machine – Shigley, J. E.
3. Theory of Machine Jagdish Lal.
4. Theory of machine – J. E. Singh – McGraw Hill