National Institute of Technology, Raipur (C.G.)													
Course of Study & Scheme of Examination in Mechanical											B.Tech. VI 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 0601	Dynamics of machines	3	1		20	15	15	50	70	120	4
2	Mech.Engg	ME 0602	Turbo Machinery	3	1		20	15	15	50	70	120	4
3	Mech.Engg	ME 0603	Energy conversion System	3	1		20	15	15	50	70	120	4
4	Mech.Engg	ME 0604	Industrial Management	3	1		20	15	15	50	70	120	4
5	Mech.Engg	ME 0605	Automobile Engineering	3	1		20	15	15	50	70	120	4
6	Mech.Engg	ME 0606	Elective-I	4	1		20	15	15	50	70	120	5
7	Mech.Engg	ME 0607	Dynamics of Machines Lab			3	30			30	20	50	2
8	Mech.Engg	ME 0608	Energy Conversion System Lab			3	30			30	20	50	2
9	Mech.Engg	ME 0609	Automobile Engineering Lab			3	30			30	20	50	2
10	Humanities	ME 0610	I & E Skill			2	25			25	0	25	1
11		ME 0611	Discipline				25			25	0	25	1
			Total	19	6	11	260	90	90	440	480	920	33

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

T.C.A.= Total of Continuous Assessment.

Subject: Dynamics of Machines

Name of the Subject	**Dynamics of Machines**	Subject Code	ME 0504
Semester	VI	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, Engg Mechanics		

COURSE OUTCOME-

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

1. Apply and identify the concept of relative motion of cam and follower mechanism for various applications
2. Visualize and identify the gear technology and the mechanical application of different gear trains.
3. Analyse and perform the static and dynamic balancing of single and multi cylinders combustion engines.
4. Expand the knowledge and application of gyroscopic couple in aircraft, marine and automobiles.
5. Analyze the importance of mechanical vibration through solving problems of one and two degree-of freedom engineering system.

SYLLABUS

UNIT- I

Cams: Classification of cams and followers, Nomenclature of a radial cam, Description of follower movement, Displacement diagrams, Uniform and modified uniform motion, Simple harmonic motion, Uniform acceleration motion and its modifications, Cycloidal motion, Synthesis of cam profile by graphical approach, Considerations of pressure angle.

Cams with specified contours: Circular arc cam & tangent cam.

UNIT – II

Gear: Types of gears, Gear terminology, Law of gearing, Gear tooth forms, Involute and Cycloid tooth profile, Interference and Undercutting of Involutes teeth, Minimum number of teeth on pinion to avoid interference.

Gear trains: Simple, Compound, Reverted, and Epicyclical gear trains, computation of velocity ratio in gear trains by different methods.

UNIT - III

Balancing: Balancing of rotating masses, Static and dynamic balancing, Determination of balancing masses in two plane balancing, Balancing of internal combustion engines, Balancing of in-line engines, Firing order, Balancing of V-twin and radial engines, Forward and reverse crank method, Balancing of rotors.

UNIT- IV

Gyroscope: Gyroscopic forces and couple, Gyroscopic effect in Airplanes, Ship motion and

Vehicles moving on curved path.

UNIT- V

Mechanical Vibrations: One dimensional longitudinal, Transverse and torsional vibrations, Natural frequency, Effect of damping on vibrations, Different types of damping. Forced vibration, Forces and displacement, Transmissibility, Vibration Isolation, Vibration sensors: seismometer and Accelerometers, Whirling of shafts with single rotor.

Text Books:

1. Theory of Machine- S. S. Rattan - Tata McGraw Hill
2. The Theory of Machines - Thomas Bevan, - CBS/ Cengage Publishers
3. Theory of Machines – J. E. Shigley – McGraw Hill

Reference Books:

1. Theory of Mechanisms and Machines- A. Ghosh, A. K. Mallik – EWP Press..
2. Theory of Machine – P.L. Ballaney – Khanna Publishers.

Subject: Turbo Machinery

Name of the Subject	**Turbo Machinery**	Subject Code	ME 0602
Semester	VI	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, Fluid mechanics		

COURSE OUTCOME-

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

1. Understand and explain principle of operation of steam turbine.
2. Understand, analyze and Draw velocity diagram in turbo machinery stages at inlet and outlet conditions.
3. Understand and detail the performance of impulse and reaction steam turbine.
4. Understand the differences between ideal and actual gas turbine.
5. Understand, analyze and Carry out detailed analysis of compressor and its operational characteristics.

SYLLABUS

UNIT – I

Impulse Turbine: Steam turbine– Principal of operation of steam turbine, Types, Impulse turbine compounding of steam turbine- pressure compounded velocity compounded and pressure– velocity compounded impulse turbine, Velocity diagram for impulse turbine, Force on the blade and work done, Blade or diagram efficiency, Gross stage efficiency. Influence of ratio of blade to steam speed on blade efficiency in a single stage impulse turbine. Efficiency of multi-stage turbine, Impulse blade sections, Choice of blade angle. Blade height in velocity compounded impulse turbine.

UNIT – II

Impulse Reaction Turbine: Velocity diagram, Degree of reaction, Impulse-reaction turbine with similar blade section and half degree of reaction (Parson's turbine), Height of reaction Turbine blade section, Internal losses in steam turbine Nozzle, Losses, Blade friction losses, Disc friction losses, Blade windage losses or partial admission losses, Gland leakage or clearance losses, Leaving velocity or residual loss, Carry loss.

UNIT – III

State Point Locus and Reheat Factor: Factor-Stage, Efficiency of impulse turbines, Stage point locus of an impulse turbine, State point locus for multistage turbine reheat factor. Internal efficiency, Overall Efficiency, Relative efficiency, governing of steam turbine. Throttle governing, Nozzle governing, Bypass governing, Combination of throttle and nozzle, Governing and combination of bypass and throttle governing. Effect of governing on the performance of steam turbine.

UNIT – IV

Gas Turbine: Classification of gas turbine, Simple open cycle gas turbine, Ideal and actual cycle (Brayton Cycle) for gas turbine, Optimum pressure ratio for maximum specific output in actual gas turbine, Regeneration, Reheat and inter cooling and effect of these modification on efficiency and output, Closed cycle gas turbine.

UNIT – V

Turbo Compressors: Introduction, Classifications of Centrifugal compressors – components, Working, Velocity diagrams, Calculations of power and efficiencies, Slip factor, Surging and choking power and efficiencies.

Axial Flow Compressor: Construction and working, Velocity diagram, Calculation of power and efficiencies, Degree of reaction, Work done factor, Stalling, Comparison of centrifugal and axial flow compressor.

Text Books:

1. Steam and Gas turbine – By R. Yadav - Central Publishing House, Allahabad.
2. Gas Dynamics with Application: S. K. Kulshrestha.

Reference Books:

1. Turbine compressors and Fans – S. M. Yahya – TMH
2. Gas Turbine – V. Ganeshan – TMH

Subject: Energy Conversion System

Name of the Subject	**Energy Conversion System**	Subject Code	ME 0603
Semester	VI	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, Fluid Mechanics		

COURSE OUTCOME-

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

1. Explain the functioning of different types of high pressure boilers.
2. Apply thermodynamics principle in and open system.
3. Differentiate various forms of non-conventional energy sources.
4. Apply the principle of momentum and thrust equation for aircraft and jet propulsion systems.

SYLLABUS

UNIT– I

Boilers: Classification of boilers, Boiler Mountings & Accessories, Draught & its classification, chimney height & diameter calculation, efficiency of a chimney, Draught Losses. Modification of boilers, High Pressure Boilers – La-Mont, Benson, Velox and Super Critical Boiler, Fluidized Bed Boiler.

UNIT – II

Steam Condensers: Function & Various types of condenser, their efficiency, vacuum efficiency and measurement. Source of air leakage, Effect of air leakage and removal, Thermodynamic analysis.

UNIT – III

Direct Energy Conversions: Tidal Energy conversion, OTEC, MHD Power System, Geothermal Energy, Conversion Technique, Thermo-electric effects, Thermo-electric & thermionic converters

UNIT – IV

Jet Propulsive Devices: Types of jet engines, Principal and operation, thrust, energy flow through jet and variation of pressure and temperature, and velocity of fluid, Thermodynamics of turbo jet, efficiency and performance, Turbo prop, Ram jet, Pulse jet, Comparison of various propulsive devices.

UNIT – V

Rocket Propulsion: Types of rocket engines**,** Basic theory, Physics equations, Classifications, Liquid propellant rockets, Its advantage, Efficiency and performance, Rocket projection and escape velocity.

Text Books:

1. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion – S. M. Yahya – New Age International Publishers
2. Thermal Engineering – R.K. Rajput.
3. Thermodynamics & Heat Engines – R. Yadav – CPH.

Reference Books:

1. Fundamental of Compressible Fluid Dynamics – P. Balachandran – PHI
2. Gas Turbine Theory & Jet Propulsion – J.K. Jain – Khanna Publishers
3. Fundamentals of Engineering Thermodynamic – R. Yadav – CPH.

Subject: Industrial Management

Name of the Subject	**Industrial Management**	Subject Code	ME 0604
Semester	VI	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 basic concepts and functions of management with understand of ethical issues.
2. To able to take the decisions regarding organizations like line and staff concept, centralization and decentralization concept, differentiation and integration concept.
3. Proper understanding of human resource management, financial management, strategic management, flexible management system.
4. To understand the scope of new concept in management like enterprise resource planning, management information system etc.
5. To understand the impact of management solutions in a global, economic, environment, and societal context.

SYLLABUS

UNIT – I

Basic Concepts and Functions of Management: Definition, Management, Science or art? System approach to Management, Social responsibility of Manager, Social responsibility and Social responsiveness, ethics and management, Functions of Management.

Management of Organizations: Nature and purpose of organizing, Formal and informal organization, Types of organization structure- Line and Staff concept, Functional design, Multi divisional form, Conglomerate form and Matrix form of organizations. Mechanistic and Organic structure, Flat and Tall Structure, Span of Control, Differentiation and Integration, Centralization and Decentralization. Fayol's guidelines for effective management: Division of Labour, Unity of Command, Unity of direction, Authority, Discipline, Initiative.

UNIT – II

Human Resource Management: Nature and Scope of Human Resource Planning, Training and Development, Recruitment and Selection, Career Growth, Grievances, Motivation and its types, Need for Motivation, Reward
and Punishment, Need want satisfaction chain, Maslow's hierarchy of needs. Quality of working life, Job enrichment and Job enlargement.

Financial Management: Functions of Financial Management, Book keeping and accounting, Financial statement Analysis, Financial Ratios, Capital Budgeting, Break-Even Analysis.

UNIT – III

Strategic Management: Concept of Strategy and Strategic Planning, Corporate strategy,

Objectives, Goal, policies, Mission and Vision, SWOT analysis, Framework for Strategy, Porter's Framework for Industry Analysis, BCG Matrix, McKinsey's7S Framework, Formulation, decision Making and Implementation of Strategy.

UNIT – IV

Management Information System: Role of information in decision making, Definition of MIS, computer based user machine system, integrated system, MIS v/s Data processing, subsystem of an MIS, MIS, DSS and Expert system. Evolution and effectiveness of Information system.

Enterprise Resource Planning: Introduction to ERP, Brief history of ERP, Importance and advantages of ERP to a company, Risks and benefits of ERP, ERP Implementation Strategies, Common ERP Packages.

UNIT – V

Flexible Systems Management: Definition of Flexibility, Connotation of flexibility, Systematic concept of flexibility, Foundation of flexible system management, Types of flexibility and its applications in management of modern organizations. Flexy tools, SAP-LAP Analysis.

Text Books:

1. Essential of Management: H. Koonz and H. Weihrich.
2. MIS conceptual foundation, structure and development, G B Davis & M H Olson.
3. Flexibility in Management, Sushil, Vikas publication, New Delhi.
4. Strategic Management– John a Pearce, Richard B Robinson: Tata McGraw-Hill Publishing Co. Ltd.
5. Organizational Behavior Concepts, Controversies Applications - Stephen, P. Robbins- Prentice Hall, Englewood Cliffs, New Jersey.
6. Financial Management – M.Y. Khan and P.K. Jain - Tata Mc-Graw Hill.
7. Competitive Advantage - Porter Michael - The Free Press.
8. Competitive Strategy - Porter Michael - The Free Press, 1985.
9. Fundamentals of Business Organizations and Management – Y.K. Bhusan – S. Chand and Sons.
10. Strategic Management – S C Bhattacharya: Wheeler Publishing, New
11. Enterprise Resource Planning: Alexis Leon – Tata Mc-Graw Hill Publishing Co. Ltd.

Subject: Automobile Engineering

Name of the Subject	**Automobile Engineering**	Subject Code	ME 0605
Semester	VI	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	IC Engine		

COURSE OUTCOME-

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

1. Understand and analyze the movements of respective components by looking at simple drawing.
2. Understand the analyze the latest trends in development of new components for automobiles.
3. Develop concepts to identify the faults of automobile by heaving the and & looking at the area of probable fault.
4. To establish the concepts of removing the faults at much lower time with low cost as compared with the method being followed traditional.
5. To create awareness with the recent developments in technologies.
6. To equip the students with sand knowledge of recent instruments & equipments used in related areas.

SYLLABUS

UNIT-I

Chassis & Frame: Layout of chassis, its main components, Types of frames, Conventional frames &
Unitized Chassis.

Springs: Purpose, Types namely leaf, Coiled, Rubber, Air, Torsion bar, Stabilizer, Telescopic damper.

Suspension system: Objects & principles of suspension system, Types, Rigid axle & Independent suspension for front & rear ends, S imple & double arm parallel & perpendicular type of suspension system, Gas filled suspension system.

UNIT – II

Clutches: Characteristics, Functions and Principles of operation of clutch, *Friction clutch:* Single plate, Multi plate, Centrifugal clutch, Positive clutch, clutch lining materials. Torque transmitted and related problems. **Fluid flywheel:** Characteristics, Construction, principles of working.

UNIT – III

Gear Box: Object of Gear Box, Air, Rolling & Gradient resistance, Necessity of Gear Box: Tractive effort variation with speed, Types of Gear Boxes: Sliding mesh, Constant mesh, Synchromesh, Automatic transmission, Overdrive, Lubrication of gear box. **Torque converter:** Principles of working, characteristics, Torque converter with direct drive, Testing of

automobiles.

UNIT – IV

Universal Joint, Types, propeller shaft, slip joint.

Differential: Functions, Single & double reduction differential, Limited slip differential.

Front Axle: Live & dead axle, Stub axle.

Back Axle: Hotch kiss drive, Torque tube drive.

Tyres: Types specification, Causes of tyre wear & rim.

Brakes & Braking system: Purpose, Principles, Layout of braking system. Classification: mechanical,

Hydraulic brakes, Master cylinder, Tandem master cylinder, wheel cylinder, Self energizing & self adjusting brakes, Disc brakes, Antiskid brakes. Power operated brakes.

UNIT – V

Steering system: Types of steering gears, Reversibility of steering, Center point steering, Steering geometry namely castor, Camber, King pin inclination, Toe in, Toe out, cornering power, Under & over steer; power steering, effect of shimmy, Condition of true rolling, Calculation of turning radius. Correct steering equation and related problems.

Electrical System: Battery construction, Maintenance, Testing and charging, Cutout, Lighting circuit, Horn, Signals.

Text Books:

1. Automobile Engineering – Vol I and II - Kripal Singh – Standard Publications
2. Automotive Mechanics – Heitner
3. Automobile Engineering – G.B.S. Narang – Khanna Publishers
4. Motor Vehicle – Newton & Steeds – Life & Sons Limited.

Reference Books:

1. Automobile Engineering - Dr. N. K. Giri – Khanna Publishers
2. Automobile Engineering – K. R. Govindan – Anuradha Agencies

Subject: Air Pollution Control (Elective-I)

Name of the Subject	**Air Pollution Control** (Elective–I)	Subject Code	ME0606-1
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	ELECTIVE	Contact Hours	55
L+T+P	4+1+0	Credits	5
Prerequisite	Fluid Mechanics		

COURSE OUTCOME-

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

1. Identify sources of air pollution and its effect, relationship between pollutant concentrations, legislation & regulation.
2. Explain about emission from IC engine &major industries along with control measures.
3. Discuss meteorological aspects of air pollutant dispersion
4. Discuss air pollution sampling& measurements, pollution control method and control equipment

SYLLABUS

UNIT - I

Air Pollution: Introduction

Air Pollution, sources & classification of air pollutants, aerosols, Primary & secondary air pollutants, Photochemical Air pollution, Effect of air pollution on human health, vegetation and materials, Pollutant concentration, types, relationship between different concentration Air pollution indices, determination of index, Air pollution legislation & regulations (1981 & 1986)

UNIT - II

Air pollution: Transportation & Major Industries

Air pollution due to automobiles, types of emission from IC Engines, Effect of various operating variables on exhaust emission, control of emissions from IC Engines. Air pollution from major industries: Fe & Steel Industry, Thermal Power Plants Cement Industries. Smoke, measurement of smoke and its control.

UNIT – III

Meteorological Aspects of Air pollutant Dispersion

Temperature Lapse rates & stability, wind velocity and turbulence, Plume Behaviour, Dispersion of air pollutants, the Gaussian Plume Model.

UNIT – IV

Air Pollution Sampling & Measurement

Types of pollutant sampling techniques and measurement, Ambient Air Sampling, collection of gaseous air pollutants and particulate pollutants, stack sampling techniques, analysis of air pollutants.

UNIT – V

Air Pollution control methods & Equipment

Air pollution source correction methods: Process changes, equipment modification/ machinery replacement etc. Gases/ Odour control: Combustion, Absorption, Adsorption. Control equipments: Objectives and choice of control equipment, Settling chamber, Inertial separators, Cyclones, filters, Electrostatic Precipitator, Scrubbers.

Text Books:

1. Air Pollution- M.N. Rao, H.V.N. Rao, Tata McGraw Hill Company.
2. Air Pollution control Theory- Martin Crawford, Tata McGraw Hill Company.
3. Environmental Pollution Control Engineering - C.S. Rao, New Age International Limited Publishers.

Subject: Robotics (Elective-I)

Name of the Subject	**Robotics** (Elective-I)	Subject Code	ME0606-5
Semester	VI	Board of Studies	Mechanical Engg.
Maximum Marks	70	Minimum Marks	25
Type of course	Elective	Contact Hours	55
L+T+P	4+1+0	Credits	5
Prerequisite Engg	Mathematics, Theory of Machines, Dynamics of Machine, Machine design I and II		

COURSE OUTCOME-

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

1. To be familiar with serial robotic manipulators.
2. To apply various transformations for kinematic modeling of serial robotic manipulators.
3. To develop forward and inverse kinematic models of serial robotic manipulators.
4. To understand use of sensors in serial robotic manipulators.
5. To understand path planning and control of serial robotic manipulators.

SYLLABUS

UNIT – I

Introduction: Fixed & Flexible Automation, Evolution of Robots and Robotics, Laws of Robotics, Progressive, Advancement in Robots, Manipulator Anatomy, Arm Configuration & work space, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Actuators, Sensors and Vision, Programming of Robots, Applications – Material Handling, Processing Applications, Assembly Applications, Inspection Applications etc.

UNIT – II

Coordinate Frames, Mapping and Transforms: Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices. Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modelling of the Manipulator, Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation matrix.

UNIT – III

Kinematic Modelling of Robots: Position analysis – Direct and Inverse Kinematic Models of Robotic
Manipulators, Various examples. Velocity Analysis – Jacobian matrix.

UNIT – IV

Robotic Sensors and Vision: Sensors in Robotics, Classification, Characteristics, Internal Sensors – position, velocity, acceleration sensors, Force sensors, External sensors – proximity, touch and slip sensors. Robotic vision, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Components of Vision System, Image Representation, Image Processing.

UNIT – V

Motion Planning and Control of Robot Manipulators: Trajectory planning of Robotic

Manipulator: Joint Space and Cartesian Space techniques. Open and Close Loop control, Linear control schemes, Examples of Control models.

Text Books:

1. Robotics & Control – R. K. Mittal & I. J. Nagrath – TMH Publications.
2. Introduction to Robotics Analysis, Systems Applications by Saced B. Niku, Pearson Education.

Reference Books:

1. Kinematics and Synthesis of linkages – Hartenberg and Denavit – McGrew Hill.
2. Robotics Control Sensing, Vision and Intellgence – K.S. Fu, McGrew hill Book co.
3. Robotic Engineering – An Integrated Approach by R. D. Klafter – PHI Ltd. Delhi.
4. Introduction to Robotics by S. K. Saha – Mc Grew Hill.
5. Introduction to Robotics – Mechanics and Control by John J. Craig – Pearson Education.