Devi Ahilya University, Indore, India Institute of Engineering & Technology				BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours per Week			Marks					
4ME102,MACHINE DESIGN -III	L	T	P		TH	CW	SW	PR	Total
	4	-	4	Max	100	50	50	50	250
Duration of Theory Paper: 4 Hours				Min	35	25	25	25	110

Objective and Pre requisites: The objective of the subject to introduce the students about the new and advanced methods of design like optimization in design, reliability based design, high temperature resistance design etc. Pre requisites are Machine Design I & Machine Design II.

COURSE CONTENT

UNIT-1
Design for Bearings
Introduction about different types of bearings, Design for Journal bearing: Specifying bearing modulus, minimum oil film thickness, flow of oil, bearing heat balancing. Elementary treatment of contact stress, Selection of antifriction bearings.

UNIT-2
Reliability and Optimum based Design
Introduction to optimum design, analysis of simple machine members based on optimum design. Fundamentals of reliability ,System concepts in Reliability engineering. Failure distributions, Statistical analysis of failure data, Weibull analysis, dimensioning.

UNIT-3
Design for Tool Drive
Design of machine tool drives such as lathe, drilling and milling machine, speed diagram, ray diagram, preferred number.

UNIT-4
Design for Creep
Introduction to Design for creep. Combined creep and fatigue failure prevention. Design for low temperature (Brittle failure). Design for corrosion, wear, hydrogen embrittlement, fretting fatigue and other combined modes of mechanical failure.

UNIT-5
Design for Un-symmetrical Bending
Design of parts of unsymmetrical sections, shear center, parts subjected to unsymmetrical bending.

Note: Only Mechanical Engineer's Handbook, Data-books and certified notes are allowed in the examination hall.

BOOKS RECOMMENDED:

[1] Shingley J.E., *Mechanical Engineering Design*, McGraw-Hill ,4e,2003.
[2] Spotts M.F.,Shoup T.E., Hrnberger L.E., *Design of Machine Elements*, Pearson Education ,8e,2006
[3] Sharma P.C. and Aggarwal D.K., *Machine Design*,S.K.Kataria & Sons,11e,2006
[4] Shariff A.,*Design of Machine Elements*,Dhanpat Rai Publications(P) Ltd.,3e,1995
[5] Maleev V.L*., I.C.Engine Design*, , Mc.Graw Hill ,1e,1945
[6] Black and Adams*, Machine Design*, Mc.Graw Hill, 2e, 1968
[7] Mubeen A., *Machine Design*, Khanna Publishers, 4e, 2005

LABORATORY EXPERIMENTS:

1. Problem on Design of Journal Bearing
2. Problem on selection of Antifriction Bearing.
3. Problem on Reliability based design.
4. Problem on Dimensioning of parts.
5. Problem on Optimum based design.
6. Problem on Design for Tool Drive.
7. Problem on Design for creep.
8. Problem on Design for Un-symmetrical Bending.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours per Week			Marks					
4ME103, REFRIGERATION AND AIR-CONDITIONING	L	T	P		TH	CW	SW	PR	Total
	4	-	2	Max	100	50	50	50	250
Duration of Theory Paper: **3 Hours**				Min	35	25	25	25	110

Objective and Pre requisites

The basic objective of the subject is to introduce the processes involved in the refrigeration and air-conditioning to the students and the various systems used for the purpose. The Pre requisites are Thermodynamics, Heat transfer and Fluid mechanics

<center>COURSE CONTENT</center>

UNIT-1
Introduction and Air Refrigeration Systems
Introduction: Review of reversed Carnot Cycle, Coefficient of Performance, Types of Refrigeration Systems, Bell-Coleman cycle, Air-Refrigeration Cycles, systems for aircraft, Boot-strap type and simple evaporative systems, Applications of refrigeration systems.

UNIT-2
Vapour Compression Refrigeration (VCR) Systems
Thermodynamic Cycle, T-s and P-h diagrams, Analysis, effect of under-cooling and suction superheat, Limitations of VCR systems; Refrigerants: Classification, Properties and nomenclature, primary and secondary refrigerants, eco-friendly Refrigerants.

UNIT-3
Unconventional Refrigeration Systems and Future Trends
Vapor Absorption Systems: absorption cycle, Lithium-bromide system, heat-exchangers, analyzer and diffusers; The Electrolux system; Steam-Jet Refrigeration, Thermo-Electric Refrigeration. Low-temperature refrigeration: Cascade systems, Joule-Thompson effect, liquefaction of gases, application areas

UNIT-4
Psycromerty and Load Estimation
Psychrometry: Psychrometric Chart, Psychrometric properties and Processes; Psychrometers. Air-conditioning Load Estimation: Heat Transfer fundamentals; Cooling and heating load estimation, Heat transfer across the building envelope, thermal insulation, metabolism and heat exchange by the human body, thermal comfort, comfort charts; Solar Heat Gain, ventilation and infiltration. Sensible heat factors.

UNIT-5
Air Conditioning System
Air conditioning Systems: Types and selection, Air Systems, Water Systems, Room Air Conditioners – Window Type, Package Type, Split Type, Central Units. Air Supply Systems: Fans and Blowers, performance characteristics, heating and cooling coils, By-pass factors, Flow through Ducts, Losses, Duct Design Methods. Air Distribution and control Devices.
Note : Refrigerant tables, Refrigeration and Air-conditioning Data Book and certified data tables are allowed in the examination hall.

BOOKS RECOMMENDED:

[1] Stoeker and Jones, *Refrigeration and Air-conditioning*, McGraw-Hill Co, 2008
[2] Arora C.P., *Refrigeration and Air-conditioning,* TataMcGraw Hill, 2008.
[3] Prasad M, *Refrigeration and Air-conditioning*. New Age Publishers, 9e, 2008
[4] Ballaney P.L, *Refrigeration and Air-conditioning,* Khanna Publishers, 2008.
[5] Ameen Ahmadul, *Refrigeration and AirConditioning,* Prentice-Hall of India, 2006

LABORATORY EXPERIMENTS:

1. To find the coefficient of performance of Vapour compression Refrigeration (VCR) system
2. To find the Refrigeration effect of Vapour compression Refrigeration (VCR) system
3. To find coefficient of performance of Air-conditioner Trainer system
4. To find Refrigeration effect of Air-conditioner Trainer system
5. To find various psychrometric properties of Air
6. Evaluate the variour performance parameters of A Cooling Tower
7. Evaluate the variour performance parameters of Evaporative cooler
8. To prove the relation between the coefficient of performance of a Heat Pump and a Refrigerator.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours per Week			Marks					
4ME104, STATISTICAL QUALITY CONTROL & TOTAL QUALITY MANAGEMENT	L	T	P		TH	CW	SW	PR	Total
	4	-	2	Max	100	50	50	50	250
Duration of Theory Paper: 3 Hours				Min	35	25	25	25	110

Objective and Pre requisites: The objective of the subject to introduce concepts of quality & quality control. To impart the knowledge of Total Quality Management philosophy this is widely adopted by the business organizations now a day. This course will enable the students to apply the concepts of Quality in the industries & get benefited.

COURSE CONTENTS

UNIT- 1

BASIC CONCEPTS OF QUALITY

Meaning of Quality, Quality of Design, Quality of Conformance, quality of performance, Quality characteristic, Quality functions, Costs of Quality, Value of Quality, Quality control, Quality Control and inspection, Quality Policy, Objectives and organization, Quality Assurance. Statistical concept, Frequency distributions.

UNIT- 2

STATISTICAL QUALITY CONTROL

Concepts of Variations Process capability, variables and attributes, Theory of Control chart, Control chart for variable-x bar & R chart, Application of control chart for variables. Patterns of control charts. Control Chart for Attributes: **P, np.** C and demerit control charts & their application.

UNIT- 3

ACCEPTANCE SAMPLING

Fundamental concepts, OC Curve-construction of OC curve, Evaluation of parameters affecting OC curve, sampling plans: Single, Double, Multiple & Sequential sampling plans. Selection of sampling plan.

UNIT- 4

TOTAL QUALITY MANAGEMENT

Introduction to TQM :- Feature of TQM System, Application & Benefits of TQM. Objective of TQM, Scope & Approach of TQM, Key Activity Areas of TQM, Principles of TQM, Total Quality management philosophy of Deming, Juran & Philip Crossby. TQM Models – Models for TQM Implementations, Strategic tools & techniques of TQM.

UNIT- 5
RELIABILITY & ISO 9000
Basic Concept of reliability, Reliability and Quality, failures and failures modes, Causes of failure and unreliability, Maintainability and availability. System reliability models- System with components in series. Systems with parallel components. Need for Quality system, History of ISO: 9000 series of standards, features of ISO: 9000 series of standards.

BOOKS RECOMMENDED:

[1] Kapur K.C. & Lamberson, *Reliability in Engg. Design*, Wiley Eastern.

[2] Grant E.L. & Leave Worth, *Statistical Quality Control*, Tata Macgrawhill.

[3] Juran and Gryan, *Quality Planning Analysis*, Tata Macgrawhill.

[4] Mahajan M.,*Statistical Quality Control*, Dhanpat Rai & Sons(P)Ltd, 3e, 2003.

[5] Sharma D. D., *Toatal Quality Management*, Sultan Chand & Sons, 2e,2004.

[6] Besterfield, *Toatal Quality Management*, Pearson Education, 3e,2005.

LABORATORY EXPERIMENTS:
1. Study and Analysis of set parameters relating to different mathematical distributions(Variable).
2. Study and Analysis of set parameters relating to different mathematical distributions (Discrete).
3. Construction & analysis of various process control charts.
4. Performance of Acceptance Sampling for a given set of lots.
5. Analysis of tools of related to total Quality Management like QFD, Fish bone diagram etc.
6. Case studies related to Quality Problems.
7. Case studies related to Quality Control.
8. Case studies related to Quality Management.

Devi Ahilya University, Indore, India Institute of Engineering and Technology				B.E. IV Year (Mechanical Engineering)					
Subject Code and Name	Instruction Hours Per Week			Marks					
	L	T	P		TH	CW	SW	PR	Total
4ME105 OPERATIONS RESEARCH	4	-	-	Max	100	50	-	-	150
Duration of Theory Paper 3 Hour				Min	35	25			60

Objectives and Pre requisites: To develop the skills of decision making in dynamic business situations through quantitative analysis using different mathematical models like linear programming, Transportation, Assignment, Queuing etc. and Strategies formulation with the help of game theory and simulation etc.

<div align="center">COURSE CONTENT</div>

UNIT-1
Introduction
History and development of Operations Research, Scientific Methods, Characteristics, Scope, Models in Operations Research.
Linear Programming: Formulation, graphical methods, simplex method, Big- M- method

UNIT-2
Linear programming models
Assignment Models: Definition, Mathematical Representation, Formulation and Solution, Alternate optimal solution
Transportation Model: Definition, Formulation and solution, Alternate optimal solution, Stepping stone method, Modified distribution (MODI) or u-v method
Sequencing Models: Processing n jobs through two machines, m machines, and processing two jobs through m machines, Traveling salesman problem, and minimal path problem.

UNIT-3
Waiting Line and Dynamic programming Model
Models: Introduction, classification, state in queue, probability distribution of arrival and service times. Single server model (M/M/I). Multiple server model (MMS), Birth and death process.
Dynamic Programming: Introduction, Distribution characteristic, Dynamic programming approach, Optimal subdivision problem.

UNIT-4
Game Theory and Simulation
Theory of Game, Competitive game, Two persons, zero sum games, maximin and minimax Principles. Saddle point. Method of Dominance, graphical and algebraic method of solution by transforming into linear programming problem. Bidding problem. Building a simulation model, Monte-Carlo simulation and application.

UNIT-5
Network Analysis
Network diagram, Time estimation, Basic steps in PERT and CPM, PERT computation, CPM computation, critical path, Float, Cost analysis, Crashing the network

BOOKS RECOMMENDED:
[1] Taha, *Operations Research*, Tata Mc.Graw Hill.2002
[2] Wagner, *Operations Research*, PHI. New Delhi, 2003
[3] Ravindram & Philips, *Operations Research*, Tata Mc.Graw Hill.2005
[4] Gupta & Hira, *Operations Research*, S. Chand. 1e, 2008
[5] Vohra N.D, Kataria S.K, *Quantitative Techniques for Management*. Tata Mc.Graw Hill, 2004.

Devi Ahilya University, Indore, India Institute of Engineering and Technology				B.E. IV Year (Mechanical Engineering)					
Subject Code and Name	Instructions Hours Per Week			Marks					
	L	T	P		TH	CW	SW	PR	Total
4ME151 MATERIALS MANAGEMENT	4	-	-	Max	100	50	-	-	150
Duration of Theory Paper 3 Hour				Min	35	25			60

Objective and Pre requisites: To inbuilt the concepts of Materials Supply chain Management.. To impart the basics of purchase procedure of an organization inventory models and stores management within an organization. To concrete the concepts of inventory management for effective decision making related to material and inventory.

COURSE CONTENT

UNIT-1
Introduction
Objective of materials management, field and scope of material management, general analysis material quality, material planning programming. Integrated approach to Materials Management, Standardization, simplification, codification.

UNIT-2
Purchase Management
Scientific purchasing; objectives, organization of purchasing functions, Purchase cycle, Method of Buying; buying under certainty, buying under uncertainty, Purchasing under different circumstances , inspection and testing , purchasing for mass production , purchase contract , make or buy decision , material import , DGS & D rate contract.

UNIT-3
Stores Management
Stores organization, functions of scientific stores management, types of stores, store layout, store security, stores receipts, methods of storing, record – keeping & checking, issue methods, stores layout.

UNIT-4
Inventory Management
Selective control of inventory, various inventory models, quantity discounts, shortages, instantaneous production with back orders, fixed time mode, single period model of profit maximization with time independent costs, lead time , re-order point , buffer stock, models with price breaks, , POQ system.

UNIT-5
Supply chain Management
Understanding the Supply chain, Process view of the supply chain, Supply chain performance: achieving Strategic Fit, Supply chain Drivers and Obstacles

BOOKS RECOMMENDED:
[1] Lee & Dobler, *Material management.* Tata Mc.Graw Hill, 1990
[2] Arnold J.R Tony , Stephen N. Chapman and Ramakrishnan, *Introduction to Material management.* Pearson Education, 2008
[3] Gopal Krishnan, *Material Management.*Prentice Hall of India, 2000
[4] L.C.Jhamb, Materials and Logistics Managemnt, Everest Publishing House, 2004
[5] Sunil Chopara and Peter Meindl, Supply *chain Management, Strategic Planning and Operations,* Prentice Hall of India, 2003

Devi Ahilya University, Indore India Institute of Engineering & Technology				BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours Per Week			Marks					
4ME152, PRODUCTION & OPERATIONS MANAGEMENT	L	T	P		TH	CW	SW	PR	Total
	4	-	-	Max.	100	50	-	-	150
Duration of Theory Paper 3 Hours				Min.	35	25	-	-	60

Objective and Pre requisites: The objective of the subject is to provide students with an understanding of the theory underlying operations management & enable them to contribute to improved operating decisions. This course has gradually incorporated an increasing amount of quantitative methodology because quantitative techniques improved decision making.

<div align="center">COURSE CONTENTS</div>

UNIT- 1
PRODUCTION MANAGEMENT
Definition: Production Management operation function in organizations, Systems view of operations, defining, managing the operations subsystems. Framework for managing operations. Forecasting in operations. Methods of Forecasting, selection of the Forecasting models. Need for facility location planning, factors affecting plant location decisions.

UNIT- 2
OPERATIONS CAPACITY AND LAYOUT DECISIONS
Capacity planning and environment. Strategies to modify the capacity in the short run & long run. Decision tree analysis, Layout concepts, developing the process layout models & behavior, developing the product layout models (Assembly line models & behavior), manufacturing cellular layouts.

UNIT- 3
SCHEDULING SYSTEMS AND AGGREGATE PLANNING
Operations planning and scheduling systems, aggregate planning process, strategies for developing aggregate planning, master production schedule. Loading: various approaches of loading, Sequencing: priorities sequencing rules, detailed scheduling, Expediting.

UNIT- 4
MRP& INVENTORY CONTROL
Types of inventory, various models of Inventory control for EOQ, EPQ, A B C & VED analysis.
MRP: Objectives, advantages, limitations, preparation of material requirement plan, closed loop MRP,
MRP- II, introduction to ERP & SCM.

UNIT- 5
MATERIAL, MAINTENANCE & ECONMIC ANANLYSIS:
Introduction purchasing: Objectives, policies, procedure Maintenance: objectives, Importance and types of Maintenance systems Preventive and breakdown maintenance. Economic Analysis: Time Value of Money concept, Capital investment evaluation techniques- Pay back, NPV, IRR etc.

BOOKS RECOMMENDED:
    [1] Monks Joseph, *Operation management*, McGraw Hill international, 3e, 1987.
    [2] Everett E. Adam, et al, *Production & Operations Management*, Prentice – Hall of India, 5e, 2004.
    [3] Chase Richard B., et al, *Operations Management*, Tata MacGraw Hill, 11e, 2006
    [4] Agrawal R.D., *Organization & Management*, Tata MacGraw Hill.
    [5] Buffa E., *Production and Operation Management*, McGraw Hill,T/e
    [6] Martand Telsung, *Industrial Engineering & Production Management*, S.Chand & Co. Ltd, 2004.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours per Week			Marks					
4ME153,CAD/CAM	L	T	P		TH	CW	SW	PR	Total
	4	0	2	Max	100	50	50	50	250
Duration of Theory Paper: **3 Hours**				Min	35	25	25	25	110

Objective and Pre requisites: The course contents are aimed at providing the fundamental concepts of CAD/CAM and its tools to the undergraduate students of mechanical engineering. Prerequisites to this course are Engineering Drawing, Manufacturing Processes, Machine Design and Drawing and Production Engineering-I.

COURSE CONTENT

UNIT-1
Fundamentals of CAD/CAM
Introduction to CAD/CAM, CAE, CIM, Concurrent Engineering and Reverse Engineering. Computer Graphics: 2D and 3D Transformation, Concatenation. CAD/CAM Hardware: CAD/CAM workstations, Peripheral devices including input-output and storage devices. CAD/CAM Softwares.

UNIT-2
Computer Aided Design
Introduction to design process, Typical product life cycle, Areas of applications and benefits of CAD. Geometric Modeling: Wireframe and surface modeling, Parametric representation of analytical and synthetic curves and surfaces, Solid Modeling: Boundary representation, Constructive solid geometry, Parametric and variational modeling, CAD/CAM data exchange, Introduction to finite element analysis.

UNIT-3
Computer Aided Manufacturing
Introduction to CAM, Fundamentals of numerical control and computer numerical control systems, Coordinate systems, Motion and position control, Part Programming: Manual part programming, NC Codes and standards, Computer assisted part programming using APT language, Simulation of machining of 3D models using CAD/CAM software, Pocket machining and surface machining methods.

UNIT-4
Rapid Prototyping Technologies and Robotics
Introduction of basic RP techniques: StereoLithography, Selective Photo Curing, Selective Layer Sintering, Fused Deposition Modeling, Laminated Object Manufacturing,3D Printing, Applications of RP techniques. Robotics: Robot configurations, Motion and position control of robot arm, Robot applications.

UNIT-5
Group Technology and FMS
Introduction to the concept of group technology, Part classification and coding systems, Machine cell formation, Introduction to Flexible Manufacturing Systems: Types of FMS and components of FMS. Automated storage and retrieval Systems AS/RS, Automated guided vehicles (AGV), CAPP, Computer aided inspection and quality control (CAIQC).

BOOKS RECOMMENDED:

[1] Groover and Zimmers, *CAD/CAM:Computer Aided Design and Manufacturing*, PHI Private Limited.
[2] Groover Mikell P, *Automation, Production Systems and Computer Integrated Manufacturing*,2e, PHI Private Limited.
[3] Zeid Ibrahim, *Mastering CAD/CAM* Tata McGraw-Hill Edition, Tata McGraw-Hill Publishing Company Limited.
[4] Rao P.N.,*CAD/CAM Principles and Applications,*2e,Tata McGraw-Hill Publishing Company Limited.
[5] Zeid Ibrahim, R. Sivasubramanian, *CAD/CAM Theory and Practice,* Revised First Edition, Tata McGraw-Hill Publishing Company Limited.

LABORATORY EXPERIMENTS:

1. Development of 3D CAD model of a part as per given drawing using a CAD software.
2. Creating Assembly of given parts using a CAD software.
3. Development of the Drawing Views of a given part using a CAD software.
4. Study of the constructional features of the CNC Trainer Lathe.
5. Part Programming for the CNC machining of a workpart as per given drawing.
6. Simulation of the CNC machining operations using a CAM software.
7. Machining of a given workpiece as per drawing on CNC lathe.
8. Study of the CAD/CAM hardware and software.

Devi Ahilya University, Indore, India Institute of Engineering & Technology			BE IV Year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours per Week			Marks				
4ME154,VIBRATION & NOISE CONTROL	L	T	P		TH	CW	SW	PR	Total
	4	-	2	Max	100	50	50	50	250
Duration of Theory Paper: **3 Hours**				Min	35	25	25	25	110

Objective of the subject:

Objective of the subject is to deal with study of basics of the vibrations in a body, analysis of vibration phenomenon, control of vibration in machine parts, balancing. The subject also deals with Introduction of basic terminology of noise engineering and noise control. The pre requisites are Dynamics of machine, Machine Design.

COURSE CONTENT

UNIT-1
Introduction

Periodical motion, harmonic motion, period, cycle, circular frequency, amplitude and phase angles of vibration motion, non-harmonic periodic motions. Harmonic analysis, the vector method of representing vibrations, displacement, velocity and acceleration in harmonic motion, super position of simple harmonic, beats, work done in harmonic motion .

UNIT-2
System with One Degree of Freedom

System having single degree of freedom, free vibration of systems without damping, equilibrium and energy method for determining natural frequency. Raleigh's method, equivalent systems (systems with compound spring, shafts of different dia. Equivalent length, effect of mass of springs and shaft).

Free vibration of systems with viscous, coulomb and structural damping. Equations of motions-discussion of solutions.

Forced vibrations of systems with and without viscous and coulomb damping,, frequency response plots, Phase shift plots, Equivalent viscous damping, power consumption of vibration systems, forced isolation, commercial isolators, transmissibility.

UNIT-3

Systems with Two Degree of Freedom

System having two degree of freedom system, Normal mode of vibrations, Torsional systems, undamped & damped vibration in two degree of freedom system with free and forced vibration.Vehicle suspension, Undamped dynamic vibration absorber. Centrifugal absorber, friction damper. Vibration Instruments: Principle of frequency, Amplitude, Velocity and acceleration measuring instruments, Analysis of vibration records.

Electrical Analogies: Electric circuit principles, equivalent circuits

UNIT-4
Whirling of Shafts

Whirling of light flexible shaft with an unbalance disk at the Centre of its length with and without damping, discussion of speeds above and below the critical speed, Uniform shaft with and without unbalanced masses attached along its length (by Reyleigh method) for simple supported and fixed ends.

UNIT-5
Noise Control

Noise and its causes, sound pressure /intensity/ power level and their interrelation, Decibel scale, Loudness and equal loudness contours, Sound spectra and octave band analysis. Background noise. Weighted networks. Measurement of noise, effect of machine/ process noise on operators, employees and local resident's, standard of noise level and exposure limits. Methods of industrial noise control.

BOOKS RECOMMENDED:

[1] Ambekar A.G. *"Mechanical Vibrations and Noise Engineering"* Prentice-Hall of India, New-Delhi, 2e, 2006.

[2] Singh V.P.*, "Mechanical Vibration"* Dhanpat Rai& Co.(p)Ltd., Delhi, 3e, 2001

[3] Thomson W.*T "Theory of Vibration with Application"* CBS Publishers & Distriburors, Delhi, 3e, 1990.

[4] Grover GK *"Mechanical Vibrations"* Nem Chand & Brothers, 2e, 2007.

[5] Pujara Kewal *" Vibration & Noise for Engineers"*, Dhanpat Rai & Sons, Delhi, 2e,1992.

LABORATORY EXPERIMENTS:

1. To find the natural frequency of a simple pendulum.
2. To determine the radius of gyration of a compound pendulum using vibration phenomenon.
3. To determine the radius of gyration of a body using bifilar suspension method..
4. To determine the radius of gyration of a body using trifilar suspension method.
5. To determine the natural frequency of a spring mass pulley system.
6. To determine natural frequency of a spring mass system.
7. To determine the natural frequency of an undamped forced vibration system. .
8. To determine the natural frequency of a two degree of freedom system.
9. Performance analysis of damped forced vibration system.
10 Performance analysis of undamped dynamic vibration absorber.
11 Study of Vibration measuring instruments.
12To find out critical speed of shaft using whirling of shaft apparatus.
13 Study of sound level meter.

Devi Ahilya University, Indore, India Institute of Engineering & Technology				B.E. IV year (Mechanical Engineering)					
Subject Code & Name	Instruction Hours Per Week			Marks					
4ME155, AUTOMOBILE ENGINEERING	L	T	P		TH	CW	SW	PR	Total
	4	-	2	Max.	100	50	50	50	250
Duration of Theory Paper 3 Hours				Min.	35	25	25	25	110

Objectives & Pre requisites: To understand the principles and working of different systems of automobiles. Engineering Mechanics, Theory of Machines.

COURSE CONTENT

UNIT-1
Chassis and Body Engineering
Chassis classification, Types of frames, Vehicle body types & construction, Body materials, Driver's visibility and methods for improvement, Safety aspects of vehicles, Location of engine, Front wheel and rear wheel drive, Performance of Vehicle.

UNIT-2
Steering System
Front axle beam, Stub axle, Front wheel assembly, Principles of types of wheel alignment, Front wheel geometry viz. camber, Kingpin inclination, Castor, Toe-in and Toe-out, Condition for true rolling motion, Centre point steering, Directional stability of vehicles, Steering Gears , Power steering, Slip angle, Cornering power, Over steer & Under Steer. Wheels and tyres , Specifications, Types, Construction and tread pattern.

UNIT-3
Suspension System
Vehicle Dynamics and requirement of suspension , Suspension types & construction, Shock absorber, Types of leaf springs coil spring, Air spring, Torsion bar, Location of shackles, Brakes-classification & construction, Mechanical, Hydraulic & Pneumatic power brake systems, Air-bleeding of Hydraulic brakes, ABS, Performance- Braking efforts, Efficiency, Stopping Distance& time, tendency of over turning.

UNIT-4
Transmission System
Clutches-requirement, Types and construction, Gear boxes-purpose, Types and construction, Synchronizer, Gear shifter mechanism, Determination of gear ratio for vehicles, Gear box performance at different vehicle speed, Automatic transmission, Torque converters, Fluid coupling, Propeller shaft, Universal joints, CV joints, Differential gear box, Rear axle types & construction.

UNIT-V
Electrical and Control Systems
Types of storage battery, Construction and operation of lead acid battery, Testing of battery, Principle & operation of starting mechanism, Different Bendix drive systems, Starter relay switch, Electric fuel gauge, Fuel pump, Horn, Wiper, Lighting system, Head light dazzling, Signaling devices and circuit, Battery operated vehicles. Microprocessor based control system for automobiles. Intelligent automobiles control systems.
General: Car air conditioning systems and components, Indian standards for automotive vehicles exhaust emission-Bharat and Euro norms, Indian Motor vehicle act- preliminary information

BOOKS RECOMMENDED:

[1] Singh Kirpal, *Automobile Engineering, Vol.1*, Standard Pub, 9e
[2] Giri N.K*., Automotive Technology,* Khanna Pub, 4e 2009
[3] Newton & Steeds, *Automobile Engineering*, Butterworth Int.
[4] Heitner Joseph, *Automotive Mechanics, Principles and Practices*, East-West Pub.
[5] Crouse W.H., *Automotive series Part-I to VI*, Tata McGrawhill, 9e
[6] Crouse W.H., *Automotive Emission,* Tata McGrawhill
[7] BIS and Euro –I and Euro-II*, Emission standards*.

LABORATORY EXPERIMENTS
1. Study of chassis frame and body.
2. Study of steering linkage mechanism and Steering Boxes.
3. Study of Front and Rear suspension systems.
4. Study of hydraulic brake system.
5. Study of single plate clutch.
6. Study of sliding mesh, constant mesh, synchromesh gearboxes.
7. Study of transmission system-Propeller shaft, Differential, Rear axles.
8. Study of electrical circuit and, battery.