Faculty of Engineering & Technology
P.K.University
Shivpuri (MP)

Evaluation Scheme & Syllabus for
Department Of Mechanical Engineering

M.Tech .-(Automobile Engg.)
(I to IV Semester)
(Effective from session 2019-20)

EVALUATION SCHEME

M.Tech- Automobile Engg. (ME)

Semester-I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT .(25)	
MTAM-101	Design of Experiments & Research Methodology	30	70	NA	NA	100
MTAM-102	Automotive Engines & Emission	30	70	NA	NA	100
MTAM-103	Theory of Elasticity & Reliability	30	70	25	25	150
MTAM-104	Transmission System Theory & Design	30	70	25	25	150
MTAM-105	Finite Element Analysis	30	70	25	25	150
MTAM-106	Seminar-I	NA	NA	25	25	50

Semester-II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTAM-201	Enigne Design	30	70	25	25	150
MTAM-202	Chassis & Body Engg.	30	70	25	25	150
MTAM-203	Vehicle Dynamics	30	70	NA	NA	100
MTAM-204	Nosie & vibration	30	70	NA	NA	100
MTAM-205	Advance automotive electronic	30	70	NA	NA	100
MTAM-206	Seminar-II	NA	NA	25	25	50

Semester-III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT .(70)	SESS. (25)	EXT. (25)	
MTAM-301	Dissertation phase-I	NA	NA	300	300	600
MTAM-302	Seminar-III	NA	NA	25	25	50
						650

Semester-IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTAM-401	Dissertation phase-II	NA	NA	300	300	600
						600

Department Of Mechanical engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
I Year I Semester

MTAM-101 Design of Experiments & Research Methodology

Research Concepts:
Meaning, objectives, motivation, type of research, approaches, research (descriptive research, conceptual, theoretical, applied and experimental.

Formation of Research Task:
 literature review, importance and methods, sources, quantification of cause-effect relations, discussions, wheel study, laboratory experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research.

Mathematical Modeling and Simulation:
 concept of modeling, classification of mathematical models, modeling with ordinary differential equations, difference equations, partial differential equations, graphs, simulation: concept, types (quantitative , experimental, computer, fuzzy theory, statistical) processes of formulation of model based on simulation.

Experimental Modeling:
a) Definition of experimental design, examples, single factor experiments blocking and Nuisance factors, guidelines for designing experiments.
b) General model of process: I/P factors/ variables, O/P parameters /variables controllable/uncontrollable variables, dependent/independent variables, experimental validity.
c) Process optimization and design experiments methods for study of response surface, first Order design, determining optimum combination of factors, method of steepest ascent, Taguchi approach to parameter design. Analysis of results (parametric and nonparametric, descriptive and inferential data) types of data, collection of data (normal distribution, calculation of co relation coefficient) data processing, analysis, error analysis.

Different methods:
analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity/nonlinearity of model, testing adequacy of model. Testing model / hypothesis, use of computational tools, software for research work.

Report writing:
types of report, layout of research report, interpretation of results, style manuals, layout and format, style of writing, typing, references, paginations, table, figures, conclusions, appendices, writing research paper for publication based on dissertation / research work.

Landscape of Creativity:
convergent vs divergent thinking, creativity, creativity vs intelligence, creativity abilities, creativity and madness, determination of creativity, increasing creativity, creativity achievements, techniques of creativity, collective creativity.

Reference Books:

1. Willkinsion K.P. L., Bhandarkar, "Formulation of Hypothesis", Himalaya publishing, Mumbai.
2. Schank Fr, "Theories of Engineering Experiments", Tata McGraw Hill.
3. Douglas Montgomary, "Design of Experiments"
4. "Introduction to SQC" John Willy & sons.
5. Cochran & cocks, "Experimental Design", John Willy & sons.
6. John W. Besr and James V. Kahn, "Research in Education", PHI publication.
7. Adler and Granovky, "Optimization of Engineering Experiments", MIR Publications.

Department Of Mechanical engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
I Year I Semester

MTAM-102 Automotive Engines & Emission

Engine Basic Theory: Engine types and their operation, classification, Properties of I.C. engine, fuels, Actual cycle, air fuel cycle, combustion charts (Equilibrium), Two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram, supercharging, MPFI, VVT, cam less engine, Fuel Supply, Ignition,

Cooling and Lubrication Systems : Theory of carburetion and carburetors, mixture distribution, petrol injection, diesel fuel injection pumps, conventional and electronic ignition systems for SI engines, air cooling and water cooling, design aspects, forced feed lubrication system

Air Motion Combustion and Combustion Chambers: Swirl and turbulence – swirl generation, combustion in SI & CI engines, flame travel and detonation, Ignition delay,. Knock in CI engines, combustion chamber design

Air Pollution due to Automobile Exhaust: Sources of Emission, Exhaust gas constituents & analysis, Ingredients responsible for air pollution, Smoke, odor, Smog formation.

Exhaust Emission Control: Basic method of emission control, catalytic converter, After burners, reactor manifold, air injection, crank case emission control, evaporative loss control, Exhaust gas recirculation, Fuel additives .**Pollution Norms:** European pollution norms, Indian pollution norms as per Central Motor Vehicle Rules (C.M.V.R.).

Instrumentation for Exhaust Emission Measurement: Measurement procedure, Sampling Methods, Orsat Apparatus, Infrared Gas analyzer, Flame Ionization Detector (FID), Smoke meters.

Alternative Fuels: CNG, LPG, Bio-Diesel, Hydrogen, fuel cells, Eco-friendly vehicles, Electric & Solar operated vehicle Stratified Charged, Low heat rejection engine, Sankey plot, four / three valve engine, OHC engine, governing of automobile engine, New engine technology, Recent developments in I. C. engines

Reference Books
1. Introduction to Internal Combustion Engines", Richard Stone, McMillan, London
2. Vehicle and Engine Technology – Hein Heister
3. Advance Vehicle Technology - Hein Heister
4. I.C. Engine by Ganeshan V., McGraw Hill Book, Co.

Department Of Mechanical engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
I Year I Semester

MTAM-103 Theory of Elasticity & Reliability

Stress – Strain:
Introduction, stress and strain sensors, strain displacement relation for plane stress and plain strain problems of elasticity, equation of equilibrium, compatibility condition, stress function, simple two dimensional problems of elasticity, Analysis of torsion of circular and noncircular sections

Fatigue and Fracture:
Introduction to fatigue and fracture mechanics of ductile and brittle fractures mechanism of fatigue failure, factors affecting fatigue, methods of improving fatigue strength, cumulative damage theories, linear elastic fracture mechanics, finite life, infinite life, design of machine components

Creep:
Mechanism of creep failure, Constant load constant temperature tests, Extrapolation of creep and creep rupture curves, Creep relaxation, influence of combined load in different Directions, design of machine element used in high temperature services.

Environmental Considerations in Design:
Corrosion, corrosion under stress, fretting corrosion and effects of other chemicals, Methods of improving corrosion resistance.

Reliability Engineering:
Concepts of reliability, Statistical Models of reliability, Reliability of hazard functions, System reliability, Redundancy techniques in system design, Failure modes, effects & criticality analysis, Fault tree analysis, Event tree analysis, Design review & validation,
Design for reliability

Reference Books
1. Advances in Engineering Vol. 4 – Fatigue Design Handbook (SAE)
2. Failure of Material in Mechanical Design – J. A. Collins
3. Experimental Stress Analysis – J.W. Bally &W. F. Riley
4. Principles of Reliability – Pierusehka
5. Practical Reliability Engineering – Patrick D.T.O. Conner
6. Reliability Based Design – S. S. Rao.

MTAM-104 Transmission System Theory & Design

Transmission systems:
Clutch, types of clutch, clutch design, Gear box, types of gear boxes, gear box design, overdrive gears, Fluid flywheel & torque converter, Epicyclic gear box, semiautomatic & automatic transmission Propeller shaft,

Design of Transmission systems:
 propeller shaft, slip joint, universal joint, Final drive, differential, Dead & live axle, axle design, Constant velocity joints

Braking system:
Types of brakes, brake-actuating mechanisms, factors affecting brake Performance, power & power assisted brakes, Brake system design, and recent developments in transmission & braking system

Steering systems:
Front axle types, constructional details, front wheel geometry, Condition for True rolling, skidding, steering linkages for conventional & independent suspensions, turning radius, wheel wobble and shimmy, power and power assisted steering,

Tyre selection:
 air resistance, rolling resistance, requirement of engine power, transmission system layout, four wheel drive, transfer case.

Reference Books :
1. The Automotive Chassis – Engineering Principle – Reimpell J.
2. Automotive Chassis – Design & Calculation – P. Lukin, G. Gasparyarts, V. Rodionov, MIR Publishing, Moskow
3. Automotive Chassis – P. M. Heldt, Chilton Co. NK
4. Mechanics for Road Vehicles – W. Steed, Illiffe Books Ltd., London.

LIST OF EXPERIMENTS:-
   1. Study of clutches
   2. Study of gear box.
   3. Study of transmission shaft
   4. Study of brakes
   5. To design differential using mat-lab.
   6. To design axles using mat-lab

MTAM-105 Finite Element Analysis

Introduction:
Basic concepts of FEM – Historical background, relevance and scope for FEM – need for approximation, weighted residual, Ritz and Galerkin method, variational, weak formation

General procedure of FEM:
Discretization, interpolation, shape function, formulation of element characteristics matrices, assembly and solution

Formulation of element characteristic matrices and vectors for elasticity problems :
One-dimensional elasticity – two dimensional elasticity – three dimensional elasticity, axisymmetric elasticity Formulation of element characteristics matrices and vectors for field problems, thermal problems – one dimensional, two dimensional and three dimensional heat transfer – axisymmetric heat transfer – torsion problems

Higher order and iso-parametric formulations:
Natural coordinates system and numerical integration – higher order one – dimensional, two – dimensional and three dimensional elements – structural beam, plate and shell elements- iso-parametric elements – iso-parametric formulation.

Computer Implementation:
An overview of FE analysis program, preprocessing, solution, post processing.
.
<u>**Reference Books:**</u>
1. An Introduction to the Finite Element Method- J. N. Reddy, McGraw Hill
2. The Finite Element Method in Engineering- S. S. Rao, Pergaman Press.
3. Finite Element Analysis Theory and Practice- M. J. Fagaan, Longman Scientific and Technology.
4. Concept and Applications of Finite Element Analysis- R. D. Cook, John Wiley and sons Inc.
5. Finite Element Handbook – H. Kardestuncer
6. Rajasekaran. Finite Element Analysis in Engineering Design. Wheeler Publishing, New Delhi.
7. K. Bathe. Finite Element Procedures. Prentice-Hall of India (P) Ltd., New Delhi.

Department Of Mechanical engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
I Year II Semester

MTAE-201 Engine Design   L-T-P: 3-1-2

Introduction:
Determination of engine power, Engine selection, swept volume, stroke, bore & number of cylinders, Arrangement of cylinders stroke to bore ratio. Design procedure of theoretical Analysis, Design considerations

Material selection & actual design of components –
Cylinder block deign, cylinder head design, piston & piston pin design, piston ring design, connecting rod design, crankshaft design, flywheel design, design of valve mechanism

Engine balancing:
Firing order, longitudinal forces, transverse forces, pitching moments, yawing moments, Engine layout, major critical speed & minor critical speed, design of engine mounting,

Design of cooling system –
design principles of exhaust & inlet systems, Primary design calculation of major dimensions of fuel injection system
.
Reference Books:
1. I. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York
2. Engine Design – Giles J. G., Lliffe Book Ltd.
3. Engine Design – Crouse, Tata McGraw Publication, Delhi
4. I.C. Engine byMaleev V. L., McGraw Hill Book, Co.
5. Machine Design-RS Khurmi , Scand publication India.

LIST OF EXPERIMENTS:-
1. Heat balance sheet of IC engine

2. Design of cylinder using simulation software.

3. Design of connecting rod using simulation software.

4. Design of piston using simulation software.

5. Study of engine vibration sources

Department Of Mechanical engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
I Year II Semester

MTAE-202 Chassis & Body Engineering   L-T-P: 3-1-2

Vehicle Aerodynamics:
Objects- vehicle drag and types, various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, principle of wind tunnel technology, flow visualization techniques, tests with scale models.

Car Body Details:
 Types of car bodies, visibility, regulations, driver's visibility, methods of improving visibility, safety design, constructional details of roof, under floor, bonnet, boot, wings etc, Classification of coach work.

Design of Vehicle Bodies:
Vehicle body materials, Layout of the design, preliminary design, safety, Idealized structure-structural surface, shear panel method, symmetric and asymmetrical vertical loads in car, longitudinal loads.

Different loading situations-
load distribution on vehicle structure, Calculation of loading cases, stress analysis of bus body structure under bending and torsion, stress analysis in integral bus body.

Design of chassis frame:
Rules and regulations for body, recent safety measures, testing of body.

Reference Books:
1. Vehicle Body Engineering – Pawloski J., Business Books Ltd.
2. The Automotive Chassis: Engineering Principles – Reimpell J.
3. Vehicle Body Layout and Analysis – John Fenton, Mechanical Engg. Publications Ltd. London
4. Body Construction and Design – Giles J. G., Illife Books, Butterworth and Co.

LIST OF EXPERIMENTS:
1. To study different parts of chassis.
2. To do and study the Wheel alignment.
3. To do and study wheel balancing.
4. To do and study the different loading conditions of chassis.
5. To study and design a chassis

MTAE-203 Vehicle Dynamics

Suspension system –
requirements, types, air suspension, rubber suspension, Shock absorbers, design of leaf spring, coil spring and torsion bar, types of drives-Hotchkiss and torque tube,

Wheel alignments: wheel wobble, wheel shimmy, pitching, bouncing and rolling, roll centre and roll axis, anti-roll bar, road holding,

Handling Characteristics:
Steering geometry, Fundamental condition for true Rolling, Akerman's Steering Gear, Davis Steering gear, Steady state Handling - Neutral steer, Under steer and over steer, Steady state response, Yaw velocity, Lateral Acceleration, Curvature response & Directional stability, jack-knifing in articulated vehicle, loading of automobile chassis due to road irregularities,, comfort criteria, load transferred while braking and cornering, equivalent wt.of vehicle.

Ride Characteristics:
Human response to vibrations, Single degree & Two degree freedom, Free & Forced vibrations, Vehicle Ride Model, Two degree freedom model for sprung & unsprung mass, Two degree freedom model for pitch & bounce, Vibrations due to road roughness and engine unbalance, Transmissibility of engine mounting, Motion of vehicle on undulating road & Compensated suspension systems.

<u>**Reference Books:**</u>
1. Theory of Ground Vehicles - J. Y.Woung - John Willey & Sons, NY
2. Steering, Suspension & Tyres – J. G. Giles, Illefe Books Ltd., London
3. Mechanics of Road Vehicles – W. Steed, Illefe Books Ltd. London
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK

Department Of Mechanical engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
I Year II Semester

MTAE-204 Noise & Vibration

Noise:

Noise characteristics, Sources of noise, noise level measurement techniques, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises etc.

Noise Testing & Noise Control:

Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management.

Road vehicle noise standards Vibration:

Introduction, Single degree of freedom, damped, forced vibration, Multi degree of free vibration, modes, nodes, Holzer's method. Multi degree of freedom of vibration, matrix method, eigen values and vectors, natural frequencies & modes.

Model analysis:

Numerical methods for solution, Lagrange's equation for problem formulation, Two degree of freedom system, co-ordinate, coupling, solution Vibration under periodic force, use of Fourier series

Vibration of continuous systems:

Transverse vibration of cable, bar, torsion vibration of shaft, Rayliegh's method, Reyliegh-Ritz method Vibration control, Balancing of reciprocating & rotating masses, controlling natural frequencies, vibration isolation, vibration absorbers. Basics of non-linear vibration, causes of non-linearity, formulation, solution methods, iterative, graphical, methods of isoclines, stability of equilibrium state, types of singularity, limits cycle. Basic vibration measuring set up, brief introduction to experimental model analysis.

Reference Books:

1. Mechanical Vibration – S. S. Rao, New Age International (P) Ltd., New Delhi
2. Engineering Mechanics Static & Dynamics – I. H. Shames
3. Mechanical Vibration Analysis, P. Srinivasan, Tata McGraw Hill Pub. New Delhi
4. Non-linear Mechanical Vibration – P. Srinivasan, Tata McGraw Hill Pub. New Delhi
5. Fundamental of Mechanical Vibration – S. Graham Kelly, Tata McGraw Hill Pub.
6. Mechanical Vibration – Grover G. K., Nem Chand & Brothers, Roorkee
7. Engineering Vibration – Daniel J. Inman, Prentice Hall, NJ
8. Theory of Vibrations – W. T. Thomson, CBS Publishers, New Delhi

MTAE-205 Advanced Automotive Electronics

Fundamentals of Automotive Electronics:

Microprocessor and micro computer applications in automobiles – Components for engine management system – electronic management of chassis system, vehicle motion control, electronic panel meters.

Sensors & Actuators :

Introduction, basic sensor arrangement, types of sensors, oxygen sensor cranking sensor – position sensors – engine cooling water temperature sensors, engine oil pressure sensor, fuel metering, vehicle speed sensor & detonation sensor, stepper motors – relays.

Electronic fuel injection & ignition system:

Introduction, feedback carburetor system, throttle body injection and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state ignition system and their principles of operation, electronic spark timing control.

Digital engine control system :

Open loop and close loop control system, engine cooling and warm up control, Acceleration, detonation and idle speed control-integrated engine system, exhaust emission control engineering, on-board diagnostics, diagnostics, future automotive electronic systems,

Automotive Electrical:

Batteries, starter motor & drive mechanism, D.C. generator & alternator, regulation for charging, lighting design, dash board instruments, horn, warning systems and safety devices.

Comfort and safety :

seats, mirrors and sun-roofs, central locking and electronic windows, cruise control, in-car multimedia, security, airbag and belt tensioners, other safety and comfort systems, advanced comfort and safety systems, New developments in comfort and safety.

The system approach to control & instrumentation:

Electronics fundamentals, Electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation and telematics, new developments,

Reference Books:

1. Automobile Electrical & Electronic Equipments - Young, Griffitns - Butterworths, London
2. Understanding Automotive Electronics – Bechfold SAE 1998
3. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
4. Automotive Computer & Control System– Tomwather J. R., Cland Hunter, Prentice Inc. NJ