UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VI SEMESTER

MECHANICAL - STREAM - AUTOMOBILE ENGINEERING

SCHEME -2013

VI SEMESTER

MECHANICAL - STREAM - AUTOMOBILE ENGINEERING (U)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.601	Vehicle Maintenance (U)	4	4	-	-	50	3	100	150
13.602	Machine Design (U)	4	3	1	-	50	3	100	150
13.603	Computer Aided Design (MPU)	3	2	1	-	50	3	100	150
13.604	Heat and Mass Transfer (MSU)	4	3	1	-	50	3	100	150
13.605	Vehicle Dynamics (U)	4	4	-	-	50	3	100	150
13.606	Elective II	4	3	1	-	50	3	100	150
13.607	Computer Aided Modelling and Analysis Lab (MPU)	3	-	-	3	50	3	100	150
13.608	Electrical and Electronics Lab (U)	3	-	-	3	50	3	100	150
	Total	**29**	**19**	**4**	**6**	**400**		**800**	**1200**

13.606 ELECTIVE II

13.606.1	Artificial Intelligence Systems (MPU)
13.606.2	Mechanical Working Methods (MPU)
13.606.3	System Modeling & Simulation (MPU)
13.606.4	Materials Handling (MPU)
13.606.5	Total Quality Management (MPU)
13.606.6	Advanced Manufacturing Processes (MPU)
13.606.7	Material Characterisation (MPU)
13.606.8	Micromachining Methods (MPU)
13.606.9	Vehicle Body Engineering (U)
13.606.10	Production Process of Automotive Components (U)
13.606.11	Automotive Safety (U)

13.601 VEHICLE MAINTENANCE (U)

Teaching Scheme: 4(L) - 0(T) - 0(P) **Credits**: 4

Course Objective: To make the students familiar about

- *The various maintenance procedures involved in a vehicle as per the maintenance schedule, maintenance of various records in a service station.*
- *To be familiar with various troubles and troubleshooting related to the automobile components.*
- *Familiar with Diagnostic tools used in Automobiles for detection of problems.*

Module – I

Maintenance, Records and Schedules: Importance of maintenance, types of maintenance, Inspection, scheduled maintenance, Job card, PDI chart, requirement of service station, service station records (stores & maintenance), layout and personnel for service station, Typical maintenance schedule for two wheeler, LMV and HMV

Engine trouble diagnosis and tune-up: Overhauling of engine - types of overhauling (Top overhauling and major overhauling), specific tools used for overhauling, de-carbonizing and degreasing, engine time up, Engine fault diagnosing instruments, use of automobile stethoscope, computerized engine analyzers/scanners, OBD II usage for troubleshooting, troubles and troubleshooting related to engines.

Module – II

Maintenance and Repair of chassis components: Servicing of clutch assembly, gear box, propeller shaft, troubles and troubleshooting chart on transmission, differential maintenance and repair, backlash adjustment, servicing of braking system, identification and rectification of brake faults, brake testing, steering system maintenance and repair, tyre rotation, tyre re-treading, checking and adjusting of suspension system, wheel balancing, wheel alignment.

Module – III

Maintenance and repair of fuel supply, Lubrication and cooling system: Fuel pump testing , Carburetor servicing and tuning, servicing of gasoline injection system, FIP calibration and phase setting, injector testing, types of engine oils and additives, engine oil change intervals, radiator service, checking of the thermostat, servicing of coolant pump.

Module – IV

Maintenance of Auxiliaries: Maintenance of starter motor, dynamo and alternator, regulator unit, battery maintenance, methods of testing & servicing various electrical accessories like

horn, headlight (aiming and focusing), gauges, Testing the spark plug and ignition coil with special equipments, checking and setting the ignition timing in conventional engines.

References:

1. Boyce Dwiggins - *Automobile Repair Guide*, Theodor Audel and Co, Indiana.
2. Williarn.H. Crouse, Donald. L. Anglin, *Automotive Mechanics*, Tata McGraw Hill.
3. Antony E. Schwaller, *Motor Automotive Technology*, Delmar Publishers.
4. Judge A. W., *Maintenance of High Speed Diesel Engine*, Chapman Hall Ltd.
5. Judge A. W., *Motor Vehicle Engine Servicing*, 3/e, Pitman Paper Mark, London.
6. *Vehicle Service Manuals* of reputed manufacturers.
7. Narang G. B. S., *Automobile Engineering*, Khanna Publishers.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course the students would be equipped with the management of service station/garage with the knowledge of various maintenance activities connected with.

13.602 MACHINE DESIGN (U)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

To provide basic knowledge on the fundamentals of design considerations and methodology for designing of various machine elements by making use of Design Data Hand Book.

Module – I

Design Principles - Common Engineering Materials and their properties - Stresses in machine parts, Tension, compression, shear, Bending and torsional stresses, Combined stress - Stress concentration - Stress intensity factor - Fracture toughness, Factor of safety, Margin of safety Variable load, Variable stress - Endurance limit, S-N Curve-Fatigue strength and Endurance limit, Theories of failure, Combined steady and variable stress - Gerber, Goodman and Soderberg method, Design approach to fatigue-Design for infinite life and finite life, Tensile deformation of different material types - True stress and true strain, stress strain curves.

Module – II

Detachable joints - Pins, Keys, Splines, cotters, set screws, threaded fasteners, power screws, shaft couplings,

Welded joints, types of joints, strength of welds, fillet welds, stress distribution in welded joints, Eccentric loaded welded joints.

Riveted joints-Types of riveted joints, Failures of riveted joints, Strength of rivets, Design of boiler joints-longitudinal and circumferential joints, Joints for structural use, lozenge joint, Eccentric loaded riveted joints.

Module – III

Springs - Classification and use of springs - spring materials - Effect of end turns, Stress concentration - Energy absorbed, deflection, design for fluctuating loads, Vibration in springs, buckling of springs. Design of helical, coaxial and leaf springs - Length of leaf springs. Pressure vessels-thin cylinders and thick cylinders, Stresses due to internal and external pressures, hydraulic accumulators, Dilation of Pressure Vessels, Compound cylinders, Membrane stresses in built-up cylinders.

Module – IV

Shafts – Types of Shafts, Stresses in shafts, Design of shafts, Shafts subjected to combined twisting moment and bending moment, shafts subjected to fluctuating loads, Shafts

subjected to axial load in addition to combined Torsion and bending loads, Design of hollow shafts, Design of shafts on the basis of rigidity. Effect of key ways. Design of Crank shafts and propeller shafts.

Design Data Hand books

1. *Machine Design Data Handbook*, PSG Tech.,
2. Mahadevan, *Design Data Book*, CBS Pub.

References

1. M. F. Spotts, *Design of Machine Elements*, Prentice Hall of India
2. J. E. Shigley, *Machine Design*, McGraw Hill Book Co.
3. Sadhu Singh, *Machine Design*, Khanna Publishers.
4. S. C. Sharma & D. K. Aggarwal, *Machine Design*, S. K. Kararia and Sons.
5. Rajendra Karwa, *A Text Book of Machine Design*, Laxmi Publications.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Use of approved data book is permitted in the examination hall.*

Course outcome:

At the end of the course the students will be familiar in designing the components of the machine.

13.603 COMPUTER AIDED DESIGN (MPU)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

To equip students with fundamentals of computer aided design and to provide elementary algorithms in computer graphics and finite element analysis for basic engineering problems

Module – I

Computer Aided Design – Definition, Necessity for CAD, Benefits of CAD, Design process, Application of computers in Design- Geometric modelling, Engineering analysis, design review & evaluation, Automated drafting. Types of models- wire frame - surface and solid models - CSG and B-rep techniques.

Module – II

Introduction to Computer graphics, Functions of computer graphics software. Line generation algorithm- Bresenhams algorithm. Circle generation algorithm - Midpoint algorithm and Bresenhams algorithm. Coordinate Transformations – 2D and 3D - translation, scaling, rotation, mirroring, concatenation of transformations, homogeneous transformations.

Module – III

Clipping operations – introduction to point and line clipping - Cohen Sutherland point and line clipping algorithm. Hidden surface removal algorithms – z-buffer algorithm, scan line algorithm. Projections - Perspective geometry – Orthographic and Oblique projections – perspective transformations.

Module – IV

Introduction to finite element analysis-steps involved in FEM- Preprocessing, discretisation, types of elements, interpolation functions- Formulation of stiffness matrix - formulation of load vector- Transformation of coordinates-assembly of global equations-solution procedure, post processing phase. Simple problems with Axial element - beam element, CST element. Isoparametric formulation. Solution of 1D and 2D structural - linear static analysis.

References:

1. Rogers D. F. and J. A. Adams, *Mathematical Elements in Computer Graphics*, McGraw Hill Book Company, New York, 2007.

2. Hearn and Baker, *Computer Graphics*, Prentice Hall.
3. Ibrahim Zeid, *CAD - CAM Theory and Practice*, TMH, 2009.
4. Radhakrishnan P. and S. Subramanyan, *CAD / CAM / CIM*, New Age Int. Ltd, 2009.
5. Sadhu Singh, *Computer Aided Design and Manufacturing*, Khanna Publishers, New Delhi, 2010.
6. Mikell P. Groover, *CAD/CAM*, Prentice Hall, 1997.
7. Zienkiewicz O. C., R. L. Taylor and J. Z. Zhu, *The Finite Element Method, Its Basis & Fundamentals,* Dover Publishers, New York, 2013.
8. Daryl Logan, *A First course in Finite Element Method*, Thomson Learning, 2012.
9. Saeed Moaveni, *Finite Element Analysis-3rd edition*, Pearson Education, 2007.
10. Chandrupatla T. R. and A. D. Belagundu, *Introduction to Finite Elements in Engineering*, Pearson Education, 2012.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Students successfully completing this course are expected to have basic knowledge in computer aided design, capability to prepare fundamental graphics algorithms and solve basic structural problems using finite element method.

13.604 HEAT AND MASS TRANSFER (MSU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems,*
- *To apply analytical and numerical methods to solve conduction problems.*
- *To combine thermodynamics and fluid mechanics principles to analyze heat convection processes.*
- *To provide useful information concerning the performance and design complex heat transfer applications, such as heat exchangers and fins*
- *To integrate radiation aspects into real-world global heat transfer problems.*

Module – I

Modes of Heat Transfer: Conduction: Fourier law of heat conduction-Thermal conductivity of solids, liquids and gases-Factors affecting thermal conductivity- Most general heat conduction equation in Cartesian, cylindrical and spherical coordinates One dimensional steady state conduction with and without heat generation conduction through plane walls, cylinders and spheres-variable thermal conductivity conduction shape factor- heat transfer through corners and edges. Transient heat conduction-lumped heat capacity method. Critical radius of insulation.

Module – II

Elementary ideas of hydrodynamics and thermal boundary layers-Thickness of Boundary layer-Displacement, Momentum and Energy thickness (description only).

Convection heat transfer: Newton's law of cooling- Laminar and Turbulent flow, Reynold's Number, Critical Reynold's Number, Prandtl Number, Nusselt Number, Grashoff's Number and Rayleigh's Number. Dimensional analysis Buckingham's Pi theorem- Application of dimensional analysis to free and forced convection- empirical relations- problems using empirical relations.

Module – III

Combined conduction and convection heat transfer-Overall heat transfer coefficient - Heat exchangers: Types of heat exchangers, AMTD, Fouling factor, Analysis of Heat exchangers-LMTD method, Correction factor, Effectiveness- NTU method, Special type of heat exchangers (condenser and evaporator, simple problems only)

Fins: Types of fins - Heat transfer from fins of uniform cross sectional area- Fin efficiency and effectiveness. Boiling and condensation heat transfer (elementary ideas only).

Introduction to heat pipe.

Module – IV

Radiation- Nature of thermal radiation-definitions and concepts- monochromatic and total emissive power-Intensity of radiation- solid angle- absorptivity, reflectivity and transmissivity-Concept of black body- Planck' law- Kirchoff's law- Wein's displacement law- Stefan Boltzmann's law- black, gray and real surfaces-Configuration factor (derivation for simple geometries only)- Electrical analogy- Heat exchange between black/gray surfaces- infinite parallel plates, equal and parallel opposite plates-perpendicular rectangles having common edge- parallel discs (simple problems using charts and tables). Radiation shields (no derivation).

Mass Transfer :Mass transfer by molecular diffusion- Fick's law of diffusion- diffusion coefficient Steady state diffusion of gases and liquids through solid- equimolar diffusion, Isothermal evaporation of water through air- simple problems.

Convective mass transfer- Evaluation of mass transfer coefficient- empirical relations- simple problems- analogy between heat and mass transfer.

Data book: *Heat and Mass Transfer Data Book*: Kothandaraman C.P. and S. Subramanya, New age International Publishers.

References:

1. Yunus A. Cengel, *Heat Transfer: A Practical Approach*, Tata McGraw Hill Inc., 2003.
2. Holman J. P., *Heat Transfer*, McGraw Hill Inc., New York, 2007.
3. Incropera F. P. and D. P. Dewitt, *Heat and Mass Transfer*. John Wiley and sons, 2006.
4. Rajput R. K., *Heat and Mass Transfer*, S. Chand & Co, 2014.
5. Kothandaraman C. P., *Fundamentals of Heat and Mass Transfer*, Second Edition, New Age International Publishers, 2010.
6. Sachdeva R. C., *Fundamentals of Engineering Heat and Mass Transfer*, New Age Science Limited, 2009.
8. Nag P. K., *Heat and Mass Transfer*, Tata McGraw Hill Publishing Company, 2002.
9. Venketashan S.P., *Heat Transfer*, Ane books, 2011.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved data book is permitted in the examination hall.*

Course Outcome:

After successful completion of the course, the student will be able to:

- *understand the basic laws of heat transfer.*
- *apply principles of heat and mass transfer to basic engineering systems*
- *demonstrate general knowledge of heat transfer [conduction, convection, radiation], and general knowledge of mass transfer [molecular diffusion, convection].*
- *analyse the performance and design of heat exchangers.*
- *design heat and mass transfer processes and equipment.*

13.605 VEHICLE DYNAMICS (U)

Teaching Scheme: 4(L) - 0(T) - 0(P) **Credits:** 4

Course Objectives:

- *To provide the fundamental concepts and principles of performance aspects of automobiles.*
- *To gain the knowledge about the Stability of Vehicles*
- *To know about dynamics aspects related to suspension and tyres.*

Module – I

Performance of cars and light trucks: Vehicle drag-deformation of the wheel, deformation of the ground, Total resistance to a moving vehicle- air, rolling and grade resistance, power for propulsion, traction and tractive effort,

Road performance curves- acceleration, gradability and drawbar pull, acceleration time and Gear ratio for maximum acceleration(simple problems), fuel consumption and fuel economy, strategy for lowest fuel consumption, factors affecting fuel economy, CAFÉ standards, driving schedules – EPA urban and highway cycles, European driving cycles.

Module – II

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity

Vehicle handling: Steering angle, cornering force, low speed turning, high speed cornering, suspension effects on cornering, self righting torque, slip angle, over steer, under steer, steady state cornering, driving torques on steering, effect of camber, camber thrust, transient effects in cornering.

Module – III

Stability of vehicles: Distribution of weight (Three wheeled and four wheeled vehicles), stability of a vehicle on a slope, Dynamics of vehicle running on a banked track, Stability of a vehicle taking a turn, vehicle vibration and its effects, vehicle vibration with single degree of freedom, vehicle vibration due to road roughness. Transmissibility of engine mountings.

Road testing methods: Measurement of aerodynamic drag force in a coast – down test, cross wind tests, engine cooling road test, wind noise measurement on the road.

Module – IV

Suspension: Vehicle dynamics and suspension requirements, choice of suspension spring rate, chassis springs and theory of chassis springs, Gas & hydraulic dampers and choice of

damper, damper characteristics, mechanics of an independent suspension system, Roll axis and the vehicle under the action of side forces.

Tyres: Tyre types, relative merits and demerits, tyre dimensions and specifications, Ride characteristics of tyres, wheel hop, wheel wobble, wheel wander, wheel shimmy, behavior while cornering, cornering force, power consumed by a tyre, effect of driving and braking torque, factors affecting tyre life, tread design.

References:

1. Steeds W., *Mechanics of Road Vehicles*- Wildlife Book Ltd, London, 1990.
2. Thomas D. Gillespie, *Fundamentals of Road Vehicles,* SAE, 1992.
3. Wolf, Heinrich, Hucho – *Aerodynamics of Road Vehicles*, SAE.
4. Giles J.G., *Steering, Suspension and Tyres*, Wildlife Books Ltd, London, 1968.
5. Heldt P.M., *Automotive Chassis*, Chilton Co., New York, 1952.
6. Wong T. Y., *Theory of Ground Vehicles*, John Wiley and Sons, New York.
7. Giri N.K., *Automobile Mechanics*, Khanna Publishers, Delhi, 1986.
8. Kripal Singh, *Automobile Engineering-Vol-I*, Standard Publishers, Delhi.
9. Sharma R.P., *A course in Automobile Engineering*, Dhanpat Rai Publications.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course the students will gain sufficient knowledge on dynamics of vehicle and the sub systems along with the performance characteristics of vehicles

13.606.1 ARTIFICIAL INTELLIGENCE SYSTEMS (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To understand the importance of artificial intelligence in the current scenario*
- *To provide brief idea about various languages, logical ideas in LISP and streams*
- *To implement the technology of AIS in planning and production systems*

Module – I

Definition - history and applications - propositional calculus – predicate calculus - inference rules - structures and strategies for state space search - heuristic search algorithms - heuristics in games - complexity issues – control and implementation of state space search - production systems - planning - the blackboard architecture.

Module – II

Knowledge intensive problem solving - expert system technology - rule-based expert systems - model based reasoning - case based reasoning – knowledge representation problem - reasoning with uncertain or incomplete information - statistical approach - non-monotonic systems - fuzzy sets – knowledge representation.

Module – III

Languages - issues - network representation – conceptual graphs - structured representation Languages and programming techniques for AI - overview of LISP - search - higher order functions and procedural abstractions - search strategies - pattern matching - recursion - interpreters.

Module – IV

Logic programming in LISP - streams and delayed evaluation - expert system shell in LISP – network representations and inheritance – CLOS Introduction to understanding natural language - introduction to automated reasoning - introduction to machine learning.

References

1. Luger G.F. and W.A. Stubblefield, *Artificial Intelligence*, Addison Wesley, 1998.
2. Nilsson N. J., *Artificial Intelligence - A New Synthesis*, Harcourt Asia Pvt. Ltd., 2008.
3. Rich E. and K. Knight, *Artificial Intelligence*, Tata McGraw Hill, 2000.
4. Tanimotto S. L., *The Elements of Artificial Intelligence*, Computer Science Press, 1987.
5. Winston P.H., *LISP*, Addison Wesley, 1989.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able:

- *To know about the uses and applications of AIS.*
- *To understand the issues and solutions about AI languages.*
- *To understand the fuzzy sets, reasoning techniques and pattern matching.*

13.606.2 MECHANICAL WORKING METHODS (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To impart an idea about various mechanical working methods, their design, uses and problems encountered*
- *To create a skill in selecting appropriate working methods as per design requirement.*
- *To identify the relative advantages, disadvantages in selecting a machining process.*

Module – I

Introduction : Elements of mechanical processing systems – Definition of mechanical working – Hot and cold working – Comparison with other processing systems. Elastic and plastic behavior – Yielding and yield stress – Conventional stress– Strain curve and true stress-strain curve – Ductile and brittle behaviour –The flow curve. Energy and power requirements in plastic deformation – Factors affecting plastic deformation.– Deformation temperature – Rate of deformation – Friction and Lubrication. Need for preheating - Need for heat treatments after mechanical working – Heat treatment methods – Furnaces for pre heating and heat treatment.

Module – II

Materials for mechanical working - A brief survey of the characteristics and composition of the common ferrous and nonferrous alloys and nonmetallic materials used for mechanical working.

Rolling Metals – Fundamental principles of metal rolling classification of rolled products, types and sizes –Basic principles of draughting schedule design and roll pass design (simple examples) Roll load and power required in rolling – Problems encountered and defects in rolling practice.

Module – III

Forging, Extrusion and Wire drawing – Principles of product design and die design in forging – Calculation of forging loads and selection of hammers and process for forging – Design of extrusion and wire – drawing dies –Computation of power requirements problems encountered and defects in the above processes.

Module – IV

Press working of metals – Description and classification of the processes – Product and die design for shearing, blanking drawing and bending –Compound and progressive dies – Computation of capacities and tonnage requirements for blanking, piercing and drawing operations – Process selection and selection of process problems and defects in press working.

References

1. Campbell, *Principles of Manufacturing Materials and Processing*, McGraw Hill, 1984.
2. Alexander Brower, *Manufacturing properties of Materials*.
3. Cole C. B., *Tool Design*.
4. ASTME, *Fundamentals of Tool Design*, Fifth edition, 2010.
5. Richard Little, Metal Working Technology, McGraw Hill, 1977.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the features of different mechanical working methods*
- *To get sufficient knowledge in hot and cold working, rolling, forging, extrusion and wire drawing and press working*
- *To design and develop elements of mechanical processing systems.*

13.606.3 SYSTEM MODELING & SIMULATION (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce different system modelling and simulation techniques.*
- *To illustrate about analytical models, random number generations, validation of models and simulation software.*
- *To provide a brief idea about simulation languages, alternative modelling and simulators.*

Module – I

System concepts - components of a system - discrete and continuous systems - types of system study - system analysis - system design and system postulation - system modelling - types of models - system simulation - steps in a simulation study - comparison of simulation and analytical models - Monte Carlo simulation – examples of simulation of single server, single queue systems and simple inventory systems - concepts in discrete event system simulation - event scheduling/time advance algorithm - modelling world views.

Module – II

Random number generation - techniques for generating random numbers - tests for random numbers - frequency tests - the Kolmogorov-Smirnov test and the Chisquare test - random variate generation - inverse transformation method - exponential, uniform and empirical discrete and empirical continuous distributions - Input modelling for simulation - data collection -identifying the distribution using histograms - parameter estimation - Chi-square goodness of fit test Verification and validation of simulation models - verification of simulation models - calibration and validation of models - face validity.

Module – III

Validation of model assumptions and validating input-output transformations - output analysis for a single model - types of simulations with respect to output analysis, .Measures of performance and their estimation - output analysis for terminating simulations - confidence interval estimation for a fixed number of replication - confidence intervals with specified precision - output analysis for steady-state simulations - initialization bias - replication method - sample size determination for a specified precision - batch means method.

Module – IV

Simulation modelling and analysis of manufacturing systems - objectives - performance measures - issues in simulation of manufacturing systems – simulation of simple job shop manufacturing systems - Introduction to simulation software for manufacturing applications - salient features of simulation languages such as general purpose simulation system (GPSS)

and simulation language for alternative modeling (SLAM) - salient features of simulators such as WITNESS and ARENA.

References

1. Banks J., J.S. Carson and B.L. Nelson, *Discrete-Event System Simulation*, Prentice Hall of India Private Limited, Fifth edition, 2009.
2. Askin R.G. and C.R. Standridge, *Modelling and Analysis of Manufacturing Systems*, John Wiley, 1993.
3. Deo N., *System Simulation with Digital Computer*, Prentice-Hall of India, 1978.
4. Gordon G., *System Simulation*, Prentice Hall of India, 2/e, 1989.
5. Law A.W. and W. D. Kelton, *Simulation Modelling and Analysis*, 3/e, McGraw Hill International Editions, 2014.
6. Kelton W. D., R. P. Sadowski and D. A. Sadowski, *Simulation with ARENA*, WCB/McGraw Hill International Editions, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand the principles, uses and applications of modeling and simulations.*
- *To get an overall idea about GPSS, SLAM, WITNESS and ARENA.*
- *To develop simulation software for manufacturing applications.*

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13.606.4 MATERIALS HANDLING (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To aware about the significance of material handling in production industry*
- *To learn the basics of material handling techniques and how they can be effectively and efficiently used to support facility objectives.*
- *To understand the underlying mechanisms to design, and develop material handling devices.*

Module – I

Importance of Materials Handling- Principles of Materials Handling – Principal groups of Materials handling equipment – General characteristics and applications of materials handling equipment – Modern trends in Materials handling.

Lifting equipment – hoist –Components of hoist – Load handling attachments – hooks , grabs and clamps – Grabbing attachments for bulk materials – Wire ropes – and chains.

Module – II

Lifting tackle pulleys for gain of force and speed – Tension in drop parts –Drums , shears and sprockets - Arresting gear and brakes – block brakes , band brakes , thrust brakes – Safety and hand cranks .Principle operation of EOT , Gantry and jib cranes – Hoisting Mechanisms , travelling mechanisms , lifting mechanisms – slewing mechanisms – Elevators and lifts.

Module – III

Conveying Machines - Belt conveyers – Types , principal components of a conveyor and their purpose – Conveyor belts – tractive elements – take up devices – Special types of belt conveyors - Metal belt conveyors – Apron conveyors – Elevators , Passenger conveyors – Flight conveyors , Principal types and applications – Bucket flight conveyors – Cradle conveyors – Conveyor elevators.

Module – IV

Overhead Conveyors – Principal types and applications – Overhead pusher conveyor Overhead load towing truck conveyors – Load carrying car conveyors – Load towing and walking beam conveyors – Bucket elevators – Cradle conveyors – Screw conveyors - Oscillating conveyors – Roller conveyors – Hydraulic and pneumatic conveyors – Chutes – bins.

References

1. Rudanko, *Material Handling Equipment*. Mir Publishers, 1969.
2. Alexandr V, *Material Handling Equipment*, Mir Publishers, 1989.
3. Spivakvsky A. and V. Dyachkov, *Conveying Machines,* Peace Publishers, 1989.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To effectively design and analyze material handling devices.*
- *To describe the safe work practices utilizing various types of hoisting and conveying equipment.*
- *To identify industry regulations necessary for material handling operations.*

13.606.5 TOTAL QUALITY MANAGEMENT (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in various business organizations.*
- *To introduce about TQM principles, customer orientation and management tools.*
- *To provide an idea about quality standards.*

Module – I

Introduction to the concept of quality - Small 'q' & Big 'Q'- Total quality mode– internal and external customer -TQM axioms Quality management philosophies: Major contributions of Deming, Juran and Cross by to quality management- Juran Trilogy, PDCA Cycle, 5S, Kaizen – Cost of quality, quality and cost-Characteristics of quality cost - Barriers to TQM Implementation.

Module – II

TQM Principles-Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation. Quality planning: SWOT analysis-Strategic planning-strategic grid-organizational culture.

Module – III

Customer orientation: Customer focus-customer satisfaction model-customer retention model-Quality Function Deployment, Problem solving process: Steps involved in problem solving-Quality control tools: Brain storming-Histograms-Check sheets- Pareto diagram-Ishikawa diagram-Control charts-Scatter diagram.

Module – IV

Introduction to seven new management tools. Continuous improvement strategies: Deming wheel- Zero defect concept- Six sigma approach – application of six sigma approach to various industrial situations. Quality circles- Benchmarking- Quality standards – Need of standardization - ISO 9000 series – ISO 14000 series – Other contemporary standards.

References

1. Dale H. Besterfiled, *et al*., *Total Quality Management*, Pearson Education, Inc., 2003, (Indian reprint 2004).

2. Suganthi L. and A. A. Samuel, *Total Quality Management*, Third edition, Prentice Hall of India New Delhi.
3. Sridhara Bhat K., *Total Quality Management -Text and Cases*, Himalaya Publishing House, 2010.
4. James R. Evans and William M. Lidsay, *The Management and Control of Quality*, (5th Edition), South-Western (Thomson Learning), 2002.
5. Feigenbaum A. V., *Total Quality Management*, McGraw Hill, 1991.
6. Oakland.J.S., *Total Quality Management*, Butterworth Heinemann Ltd., Oxford, 1989.
7. Narayana V. and Sreenivasan, *N.S. Quality Management – Concepts and Tasks*, New Age International, 1996.
8. M Zairi., *Total Quality Management for Engineers*, Wood Head Publishers, 1991.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

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

- *To know the principles of total quality management and peculiarities of their implementation.*
- *To be able to use quality management methods analyzing and solving problems of organization.*
- *To know business excellence models and be able to assess organization's performance making reference to their criteria.*

13.606.6 ADVANCED MANUFACTURING PROCESSES (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide an idea about the advanced machining theory and practice techniques used in industry.*
- *To develop an ability to look for the unconventional manufacturing process to machine the objects*
- *To understand appreciate the latest manufacturing process in fabrication.*

Module – I

Advances in casting: Newer casting processes - plaster mould and ceramic mould casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming-Rapid solidification for Amorphous alloys. Powder metallurgy processes: Methods of Powder production – Blending of metal powders- Compaction of metal powders- Sintering – hot pressing – Isostatic pressing – hot and cold (HIP and CIP), selective laser Sintering.

Module – II

Other shaping processes – Metal Injection moulding, pressure less compaction, ceramic moulds – spray deposition - Finishing of sintered parts. Manufacturing processes for plastics: Extrusion, Injection, Blow and rotational moulding of plastics-Thermoforming-Compression moulding – Transfer moulding – Foam moulding.

Module – III

Processing of reinforced plastics and composite –Moulding – compression, vacuum bag – contact – resin transfer – transfer / injection. Filament winding. Rapid prototyping and rapid tooling: Introduction – Stereo lithography – Fused deposition moulding – selective laser machining – Laminated object manufacturing – solid base curing – Direct manufacturing and rapid tooling.

Module – IV

Manufacturing processes for MEMS: Introduction to MEMS – semiconductors and silicon – crystal growing and wafer preparation –Films and film deposition – Oxidation- Lithography-diffusion and Ion implementation – Etching – wet etching – dry etching – wire bonding and packaging – printed circuit boards – Micro machining – Bulk micro machining – surface micro machining- Single crystal silicon reactive etching (SCREAM) - silicon micro machining by single step plasma etching (SIMPLE) – Etching combined with fusion bonding – LIGA micro fabrication process – Solid free form fabrication.

References

1. Serope Kalpakjian, Steven R. Schemid, *Manufacturing processes for Engineering Materials*, Fourth edition, Pearson Education, 2003.
2. Serope Kalpakjian, *Manufacturing Engineering and Technology*, Third Edition-Addison-Wesley Publication Co., 1995.
3. Brahem.T.Smith, *Advanced machining*, I.F.S., U.K., 1989.
4. Amstead B. H., Ostwald Phylips and R.L. Bageman, *Manufacturing Processes*, John Wileys Sons, 1987.
5. Muccic E. A., *Plastic Processing Technology*, Materials Park, OHIO, ASM Int., 1994.
6. Jaeger R. C., *Introduction to microelectronic Fabrication*, Addison-Wesley, 1988.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

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

- *To learn the art of manufacturing new products due to the development of new materials and process.*
- *To select suitable process while fabricating new machine parts.*
- *To get information in SCREAM, SIMPLE, LIGA process*.

13.606.7 MATERIAL CHARACTERISATION (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide basic descriptions of a range of common characterization methods for the determination of the structure and composition of solids.*
- *To introduce the Scope of optical metallographic studies.*
- *To understand the major components of material characterization essential to the understanding of the physical properties of solids.*

Module – I

Scope of metallographic studies in materials science. Understanding image formation, resolution of a microscope, numerical aperture, magnification, depth of field and depth of focus. Important lens defects and their correction, principles of phase contrast. Bright field and dark field contrast, sample preparation. Optical microscopy, interference and polarized light microscopy, quantitative analysis using optical microscopy (inclusion analysis, grain size determination volume fraction of phases etc.).

Module – II

Production and properties of X-rays, X-ray diffraction, Bragg's law of diffraction, Scattering of an electron by an atom, by a unit cell, structure factor and intensity calculations. Stereographic projection, Effect of texture, particle size, micro and macro strain on diffraction lines. Indexing of powder photographs. Chemical analysis by X-rays, Stress measurement, Particle size determination.

Module – III

Construction and working principles of transmission electron microscopes. Image formation, resolving power, magnification, depth of focus, elementary treatment of image contrast. Bright field and dark field images, sample preparation techniques. Selected area diffraction, reciprocal lattice and Ewald sphere construction, indexing of selected area diffraction patterns.

Module – IV

Scanning electron microscopy: construction; interaction of electrons with matter, modes of operation, image formation, resolution and magnification. Energy Dispersive Spectroscopy, Wavelength Dispersive Spectroscopy.

References

1. Gifkins R.C., *Optical Microscopy of Metals*, Sir Isaac Pitman and Sons LTD, 1970.
2. Cullity B.D., *Elements of X-Ray Diffraction,* Addison Wesley, 1978.

3. Williams D.B. and C. Barry Carter, *Transmission Electron Microscopy,* Planum Press New York, 1996.
1. Goodhew P. J., J. Humphreys and R. Beanland, *Electron Microscopy and Analysis*, Taylor and Francis, 2001.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To understand microstructure investigations using optical microscopes.*
- *To explain construction of working principles of electron microscopes.*
- *To gain knowledge on different types of analyses using XRD.*

13.606.8 MICROMACHINING METHODS (MPU) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To get an overview of various techniques used for machining in the micro scale.*
- *To understand the theory of micromachining.*
- *To give an introduction about various applications of MEMS.*

Module – I

Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feedback systems. Micromechanics: Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials.

Module – II

Micro-fabrication: Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining- Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer devices.

Module – III

Mechanical micromachining: Theory of micromachining-Chip formation-size effect in micromachining- microturning, micromilling, microdrilling - Micromachining tool design. Precision Grinding-Partial ductile mode grinding- Ultraprecision grinding- Binderless wheel – Free form optics.

Module – IV

Micro electro mechanical system fabrication: Introduction – Advance in Microelectronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS.

References

1. Sámi Franssila, *Introduction to Micro Fabrication*, John Wiley and Sons, UK, 2004.

2. Madore J., *Fundamental of Micro Fabrication*, CRC Press, 2002.
3. Mark J. Jackson, *Micro fabrication and Nanomanufacturing*, CRC Press, 2006.
4. Peter Van Zant, *Microchip fabrication*, McGraw Hill, 2004.
5. Mohamed Gad-el-Hak, *The MEMS Handbook,* CRC Press, 2006

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

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

- *To gain knowledge on the structure of materials in the micro scale.*
- *To explain various micro machining processes and to differentiate its uses.*
- *To do micro machining tool design.*

13.606.9 VEHICLE BODY ENGINEERING (U) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are to provide knowledge on

- *Body material and mechanisms*
- *Different vehicle body details such as Car body details, Bus body, Commercial Vehicle details*
- *Fundamentals of Vehicle aerodynamics*
- *Testing of vehicles for safety.*

Module – I

Modern materials for vehicle design: Introduction, Structure and manufacturing technology of automotive materials, Mechanical and physical properties of automotive materials, Material selection for automotive components,

Introduction to vehicle aerodynamics, Vehicle drag and types; various types of forces and moments, effects of forces and moments, side wind effects on forces and moments, Various body optimization techniques for minimum drag, wind tunnel testing: flow visualization techniques, scale model testing.

Module – II

Body design: coach and bus body styles, typical layout of bus and coach bodies, typical layout of commercial vehicle types, passenger car body styles,

Chassis design and analysis: Chassis type, structural analysis by simple structural surface method, body frame construction, unitized frame and body construction, FR, FF, & MR body structure details.

Module – III

Ergonomics method and tool to promote occupant accommodation: standards guidelines and recommendations, Anthropometry, 2-dimentional manikins, package drawing, Quick and dirty mock ups, vehicle seating configuration (based on SAE). Crash testing: Human testing, Crash worthiness, Compliance testing.

Introduction to vehicle safety: Basic concept of vehicle safety-underlying principles, safety factors, warning and instructions, shielding, interlocking. Minor auto body repairs: types of body fillers and its application, repairing rust damage.

Module – IV

Painting: Corrosion and anticorrosion method .Paint and painting process Diagnosing major collision damage: impact and its effect on a vehicle, determining the conditions of the collision, Porto power, the dozer technique, operation of conventional Porto power,

operation of dozers, body bay systems (flexi-force), general repair techniques. Body alignment- straightening equipment, in-floor systems, chainless anchoring systems.

References

1. Pauloski, *Vehicle Body Engineering*
2. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics.
3. Robert Scharff and James E. Duffy, *Motor Auto Body Repair*, Delmar Publishers.
4. Fairbrother J., *Principles and Practice of Vehicle Body Repair*, Hutchinson
5. Page S.P., *Body Engineering*.
6. Paul Browne, *Auto Care Manual*.
7. *Redesign of Bus Bodies, Part I and Part H, CIRT*, Pune.
8. George A Peters & Barbara J. Peters, *Automotive Vehicle Safety*, SAE, 2002.
9. Julian Happian-Smith, *An Introduction to Modern Vehicle Design*, SAE 2004.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students would be familiar with the Vehicle body related aspects inclusive of the testing.

13.606.10 PRODUCTION PROCESS OF AUTOMOTIVE COMPONENTS (U) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To give an insight into the various production processes incorporated in the manufacturing sector of automotive components.*
- *To make the students aware about Recent Materials used and recent trends in manufacturing of automotive components.*

Module – I

Powder Metallurgy: Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts.
Casting and Machining: Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburettor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

Module – II

Forming Process: Forging - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles, Extrusions: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Hydroforming: Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing. Stretch forming - Process, stretch forming of auto body panels Super plastic alloys for auto body panels.

Module – III

Gear Manufacturing: Gear milling, Hobbing and shaping - Gear finishing and inspection. Welding: Oxy Acetylene flame welding, Resistance spot welding, laser beam welding applications in automobiles.

Module – IV

Recent Trends in Manufacturing of Auto Components: Powder injection moulding - Shotpeen hardening of gears - Production of aluminium MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze casting of pistons - aluminium composite brake rotors.

References

1. Haslehurst S. E., *Manufacturing Technology*, ELBS, London, 1990.
2. Rusinoff, *Forging and Forming of Metals*, D.B. Taraporevala Son & Co. Pvt. Ltd., Mumbai, 1995.
3. Sabroff A. M., et al., *Forging Materials & Processes*, Reinhold Book Corporation, New York, 1988.
4. Upton, *Pressure Die Casting*, Pergamon Press, 1985.
5. ASTME, *High Velocity Forming of Metals*, Prentice Hall of India, New Delhi, 1990.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course the students will have thorough knowledge about various production processes used in manufacturing of automobile components in the industry.

13.606.11 AUTOMOTIVE SAFETY (U) (Elective II)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To know the fundamentals of the Automotive Safety and the need.*
- *To know the various regulations related to Automotive Safety.*
- *To give an overview about the safety of passengers and the vehicle along.*

Module – I

Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle. Driver assistance systems in automobiles, Design of crash crumple zones, Modelling and simulation studies, Optimization of vehicle structures for crash worthiness.

Module – II

Types of impacts, and Impact with rebound, movable barrier tests, Analysis and simulation of vehicle in barrier impacts, Roll over crash tests, Behaviour of specific body structures in crash testing, Photographic analysis of impact tests, Regulatory requirements for crash testing.

Module – III

Vehicle safety systems: Survival space requirements, Restraints systems used automobiles, Types of safety belts, Head restraints, Air bags used in automobiles, Use of energy absorbing systems in automobiles, Impact protection from steering controls, Design of seats for safety, types of seats used in automobiles.

Module – IV

Types of sensors and working principle, construction, characteristics etc. used in different equipment. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions, National and international Regulations, Safety regulations: As Issued from time to time by Government Of India as per AIS 037 (Automotive Indian Standard) test requirements and testing procedure, Recent developments in Automotive Safety & Automotive lighting.

References

1. Watts, A. J., *et al*, *Low speed Automobile Accidents* Lawyers and Judges
2. Jullian Happian, Smith, *An Introduction to Modern Vehicle Design*, SAE.
3. Johnson W. and Mamalis A. G., *Crashworthiness of Vehicles*, MEP, London.
4. Edward .A, *Lamps and Lighting*, Hodder & Stoughton, London.

5. Olson L. P, *Forensic Aspects of Driver Perception and Response*, Lawyers and Judges.
6. Pantazis. M, *Visual instrumentation: Optical design & engineering Principles*, McGraw Hill.
7. Bosch, Automotive Hand Book, 6 /e, SAE, 2004.
8. Powloski J., *Vehicle Body Engineering*, Business Books Ltd., London.
9. Ronald K. Jurgen, Automotive Electronics Handbook, 2/e, McGraw Hill.
10. Prasad, Priya and Belwafa Jamel, *Vehicle's Crashworthiness and Occupant Protection*, American Iron and Steel Institute, USA.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students would be familiar with the vehicle and passenger safety incorporated in Automobiles along with regulations related to Automobile Safety.

13.607 COMPUTER AIDED MODELLING AND ANALYSIS LAB. (MPU)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective:

- *To train the students in Solid Modelling and Assembly of machine parts.*
- *To practice finite element approach in the design of engineering systems.*

PART: A – MODELLING & ASSEMBLY

Introduction to various modelling and assembly tools in CAD software. Exercise on the creation of solid models. Exercise on the creation of assembled models of riveted joints, cotter joints, shaft couplings and machine parts

PART: B - FINITE ELEMENT ANALYSIS

Introduction to pre-processing and post processing tools in finite element software. Exercise on the application of Finite Element Method to Engineering systems:-

(1) Structural Analysis

(2) Thermal Analysis

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of exercises prescribed.

The question paper shall consist of 2 parts.

PART- I : 50 Marks from Part-A

PART -II : 30 Marks from Part-B

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, students shall be able to understand various phases in engineering design process through modelling, assembly and finite element analysis.

13 .608 ELECTRICAL AND ELECTRONICS LAB (U)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective :

- *To obtain the performance characteristics of dc and ac machines, transformer*
- *To familiarize various electrical measurement equipments and measurement methods*

List of Experiments:

1. OCC on a DC shunt generator- determination of critical resistance, critical speed, additional resistance required in the field circuit.
2. Load characteristics of a dc shunt generator.
3. Load characteristics of DC compound generator
4. Load test on DC series motor
5. Load test on DC shunt motor
6. Load test on single phase transformer
7. Starting of three phase squirrel cage induction motor by star delta switch, load test on three phase squirrel cage induction motor
8. Load test on three phase slip ring induction motor
9. V-I characteristics of diodes and zener diode
10. Input and output characteristics of CE and CB configurations of BJTs.

    Determination of β, input resistance and output resistance
11. Drain and transfer characteristics of JFET
12. Static V-I characteristics of SCR
13. Half wave and full wave rectifiers with and without filters- observe the waveforms on CRO

Note: Students should complete at least 10 experiments from the above during the semester

Internal Continuous Assessment *(Maximum Marks-50)*

20% - Test

60% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed.

80% - Procedure, conducting experiment, results, tabulation, and inference.

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, the students will be familiar with the testing of electrical equipments.