

**AU-801 (A) – Tractor & Form Equipments**

**Unit-I Introduction:** Fundamental of Soils and machinery; different equipments, purposes and operations; Systems of Earth Moving Equipments: Engine-all systems of engine and special features like automatic timer, turbochargers, after coolers; Transmission:- Basic types and planetary transmission constructional and working principles. Hydro shift automatic trans torque converters, retarders; Hydraulics:- basic components of hydraulic systems like pumps (types); control valves, relief valves and hydraulic motors; hydraulic cylinders, circuits and controls valves

**Unit-II Final Drive:** Types of reductions, Structure and function suspensions like hydraulic suspension; brakes and steering:- hydraulic power steering, main components and circuit; tire, brakes and components and functions; Under carriage and tracked vehicles, advantages and disadvantages, tractor and components.

**Unit-III Earth Moving Equipments Management::** Earth moving equipments; maintenance; type of maintenance schedules; purpose and advantages, organization set ups and documentation; method of selection of equipments:-Selection of machines, basic rules of matching machine, selection of equipment including the nature of operation; selection- based on type of soil, based on haul distance and weather condition

**Unit-IV Calculations** of Operating capacity; estimating owning and operating cost; calculation of productivity of bulldozer shovel, wheel Landers and dump truck.

**Unit-V Safety** Methods and attachment for earth moving equipments

**References:**

1. John B. Lizedaw et-al; Tractors and their power units
2. Donald R. Hum and LGV Garner; Farm machinery and mechanism

**AU-801 (B) – Tool Design & M/c Tools**

**Unit I** Basic Features and Kinematics of Machine Tools: Features of basic machine tools; construction and operation, types of machine tools, machine tools motions, transmission-rotation in to rotation, rotation in to translation, kinematical-structures of machine tools: elementary, complex and compound structure, kinematical-features of gear shapers and gear hobbing machine.

**Unit II** Regulation of Speed: Design of gear boxes- need for variation of speed, selection of speed range, laws of stepped regulation, standardization of speeds, speed diagram, analysis of productivity loss, kinematical advantage of GP, structural diagrams, ray diagram and speed chart.

Gear Drives: Belt and cone pulley, slip gear type, north gear drive, draw key gear drive, clutch type, mechanical step less drives, electrical drives; hydraulic drive.

**Unit III** Design of Metal working Tools: Design of press working tools, shearing, piercing, blanking, dies, compound die design principles for forging dies, bending, forming drawing dies, tooling for forging design principles for forging dies, drop forging, upset forging, design principles and practice for rolling, roll press design.

**Unit IV** Design of Jigs and Fixtures: Principles of location, locating method and devices, principles of clamping, clamping devices, drilling jigs, types, drill bushes, fixture and economics, types of fixture, milling, grinding, broaching, assembly fixtures indexing jig and fixtures, indexing devices.

**Unit V** Design of Gauges and Inspection Features: Design of gauges for tolerance for dimensions and form inspection; dies and mould design for Plastics & rubber parts: compression molding, transfer molding, blow molding.

**References:**

1. Mehta N.K.; Machine Tool Design and Numerical Control; TMH
2. Sen G.C, Bhattacharya A; Principles of Machine Tools; New Central Book Agency.
3. Donaldson; Tool Design T.M.H.
4. Jain KC and Chitale AK; Text Book Of Production Engineering; PHI Learning
5. Juneja, Sekhon and Seth; Fundamentals of Metal Cutting and Machine Tools; New Age.
6. Krar SF, Gill AR, Smid P; Technology of Machine Tools;TMH
7. Sharma P.C; Production Engineering; Chand S
8. Wilson; Fundamentals of Tool Design; ASTME
9. Paqwin J.R; Die Design Handbook; The Industrial Press-NY
10. ASTME; Die Design Hand Book; McGraw Hill
11. Archinov; Metal Cutting & Cutting Tool Design; MIR Publishers Moscow
12. Kempster M.H.A; Introduction to Jig and Tool Design; FLBS.

**AU-801 (C) – Reliability & Maintenance**

**Unit 1 Basic Concepts of Reliability:** Probability distributions used in maintenance engineering- Binomial, Poisson, Exponential, Normal, Log-normal, Gamma and Weibull distribution; failure rate, hazard rate, failure modes, MTTR, MTBF, MTTF

**Unit 2 System Reliability Models:** System reliability□n-component series systems, m-component parallel systems and combined system; standby systems; K-out-of-m systems; redundancy techniques in system design; event space, decomposition (Key Stone), cut and tie sets, Markov analysis, reliability and quality, unreliability, maintainability, availability

**Unit 3 Maintenance Concepts and Strategies:** Introduction, maintenance functions and objectives, maintenance planning and scheduling, maintenance organization.

**General Introduction to Maintenance Types:** Breakdown, emergency, corrective, predictive, and preventive; maintenance prevention; design-out maintenance, productive maintenance, shutdown maintenance and scheduled maintenance.

**Unit 4 Condition Based Maintenance:** Principles of CBM, pillars of condition monitoring, CBM implementation and benefits; condition monitoring techniques- visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring

**Unit 5 Reliability Centered Maintenance (RCM):**□ Concept, methodology, benefits;  
**Total Productive Maintenance:** Evolution of TPM, TPM objectives, concept, pillars of TPM.  
**Failure Modes and Effects Analysis (FMEA)/ Failure Modes, Effects and Criticality Analysis (FMECA):** Overview, elements of FMECA, applications and benefits, risk evaluation, risk priority numbers, criticality analysis, process FMEA, qualitative and quantitative approach to FMECA; design FMEA and steps for carrying out design FMEA

**References:**

1. Ebeling CE; An Introduction To Reliability & Maintainability Engg; TMH
2. Srinath L.S; Reliability Engineering; East West Press.
3. Naikan; Reliability engg and life testing; PHI
4. Kapur KC and Lamberson LR; Reliability in Engineering Design; Wiley India
5. Telang AD and Telang A; Comprehensive Maintenance Management; PHI
6. Mishra R.C; Reliability and Maintenance Engineering; New age International publisher.
7. Balaguruswamy; Reliability Engg; TMH
8. Dhillon; Engg Maintainability- How to design for Reliability and easy maintenance; PHI
9. Davidson John; The Reliability of mechanical system; Institution of Mech. Engineers, London
10. Patrick D.T and O.'Connor; Practical Reliability Engineerin; John Wiley and Sons
11. Modarre M; Reliability and Risk Analysis, Marcel Dekker Inc CRC Press

**AU-801 (D) – Simulation & Process Modeling**

**Unit 1:** Introduction to modeling and simulation: Modeling and simulation methodology, system modeling, concept of simulation; gaming; static, continuous and discrete event simulation.

**Unit 2:** Basic concept of probability, generation and characteristics of random variables, continuous and discrete variables and their distributions; mapping uniform random variables to other variable distributions; linear, nonlinear and stochastic models

**Unit 3:** Introduction to Queuing Theory: Characteristics of queuing system, Poisson's formula, birthdeath system, equilibrium of queuing system, analysis of M/M/1 queues. Introduction to multiple server Queue models M/M/c Application of queuing theory in manufacturing and computer system

**Unit 4:** System Dynamics modeling: Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship, Simulation of system dynamics models.

**Unit 5:** Verification and validation: Design of simulation experiments, validation of experimental models, testing and analysis. Simulation languages comparison and selection, study of simulation software - Arena, Pro-model, SIMULA, DYNAMO, STELLA, POWERSIM.

**References:**

1. Law AM and Kelton WD; Simulation Modeling and Analysis; TMH
2. Gordon G., System simulation, PHI Learning
3. Banks J; Hand book of Simulation; John Wiley.
4. Taha H, Operations Research; PHI.
5. Hillier FS, Liberman GJ; Introduction to OR; TMH.
6. Deo N; System Simulation with Digital Computer; PHI Learning
7. Harrell C, Ghosh B, Bowden R; Simulation Using Promodel; MG Hill
8. Seila, Ceric and Tadikmalla; Applied Simulation Modeling, Cengage
9. Payer T., Introduction to system simulation, McGraw Hill.
10. Sushil, System Dynamics, Wiley Eastern Ltd.
11. Spriet JA; Computer Aided Modeling and Simulation, Academic Press INC; USA

**AU-802 – Vehicle Dynamics**

**Unit-I Introduction** to Vehicle Dynamics: Definition by SAE; vehicle control loop; mathematical modeling methods; multi-body system approach, Newtonian and Lagrangian formulation, method of Investigation, stability concepts.

**Unit-II Mechanics of Pneumatic Tires:** Tires construction; physics of tire; traction on dry and wet surfaces, tire forces and moments, SAE recommended practice; rolling resistance of Tire Model; ride properties of Tires.

**Unit-III Performance Characteristics** of Road Vehicle: Equation of motion; maximum, vehicle power and transmission characteristics; prediction of vehicle performance; operating fuel economy, braking performance.

**Unit-IV Handling and stability:** Characteristics of road vehicle; steering geometry, steady state handling characteristics; steady state response to steering input; transient response characteristics; direction stability effects of tire; effect of mass distribution and engine location on stability and handling.

**Unit-V Vehicle Ride Characteristics:** Human response to vibration, vehicle ride models, road surface profile as a random function, frequency response function, evaluation of vehicle vertical vibration to ride comfort criterion.

**Unit-VI Two Wheeler Dynamics:** Stability & handling, vehicle motion ride control, various vehicle models, gyroscopic effect and effect of Tire and vehicle parameters on stability and handling characteristics.

**References:**

1. Wong; Theory of Ground Vehicle; John Wiley & Sons
2. Clark S.K; Mechanics of Pneumatic Tire; NBS Monograph
3. Sohlén W; Dynamics of High Speed Vehicles; Springer N.Y.
4. Ellis J.E.R; Vehicle Dynamics; Butterworths London
5. Ramalingam K.K; Automobile engineering; Scitech pub
6. Giri N.K.; Automotive Mechanics

**List of Experiments (Please Expand it):**

1. Study of static and dynamic properties of tires
2. Study of effect of braking system on car speed down, stopping and stability
3. Study effect of vibration and noise on human comfort
4. Study effect of engine location on stability and dynamics

### **AU-803 – Refrigeration & Air Conditioning**

**Unit-I Introduction:** Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

**Unit-II Vapor compression system:** Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,.

**Unit-III (a) Vapor absorption system:** Theoretical and practical systems such as aqua-ammonia, electrolux & other systems; (b) **Steam jet refrigeration:** Principles and working, simple cycle of operation, description and working of simple system, (c) **refrigerants:** nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties

**Unit-IV Psychometric:** Calculation of psychometric properties of air by table and charts; psychometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

**Unit-V Air conditioning loads:** calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems

#### **References:**

1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. Pita ; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore
8. Jordan RC and Priester GB Refrigeration and Air Conditioning, PHI USA
9. Arora RC; Refrigeration and Air conditioning; PHI Learning

**List of Experiments (Please Expand it):**

**Refrigeration and Air Conditioning AU/ ME 803**

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plant
3. General Study and working of cold storage
4. General Study Trane Air Condition (Package Type).
5. General Study of Electrolux Refrigeration
6. General Study One tone thermax refrigeration unit.
7. General Study of Water cooler
8. General Study of Psychrometers (Absorption type)
9. General Study of Leak Detectors (Halide Torch).
10. General Study and working of Gas charging Rig.
11. General Study of window Air Conditioner.
12. General Study and working of Vapor compression Air conditioning Test rig.
13. Experimentation on Cold Storage of Calculate COP & Heat Loss.
14. Experimentation on Vapor compression Air Conditioning test rig.
15. Changing of Refrigerant by using Gas Charging Kit.

## **AU-804 – Vehicle Body Engineering**

**Unit I Car Body Details:** Types: Saloon, Convertibles, Limousine, Estate Van, Racing & Sports Car Visibility, Regulation, driver's visibility, test for visibility - method of improving visibility & space in cars -safety design equipments for car; car body construction.

**Unit II Vehicle Aerodynamics:** Objectives - Vehicles drag and types - various types of forces & moments - effect of force & moments - side wind effects on force & moments - various body optimization, technique for minimum drag- Wind tunnel testing: flow visualization techniques, Scale model testing, component balance to measure force & moments.

**Unit III Bus Body Details:** Types: Mini bus, Single Decker, Double Decker, Spirit Level & Articulated bus- bus body Layout - floor height - Engine location - Entrance & Exit location - Sitting dimensions - Construction details: Frame construction, Double skin construction - Types metals sections used - Regulation - Conventional & integral type construction.

**Unit IV Commercial Vehicle Details:** Types of body: Flat platform, Drop side, Fixed Side, Tipper body, tanker body - light commercial vehicle body types - dimension of driver seat in relation to control – Driver's cab design.

**Unit V Body Materials, Trim & Mechanism:** Steel sheet, timber, plastic, GRP, Properties of materials - corrosion - anticorrosion methods - escalation of paint & painting process; Body trim items; body mechanisms.

**Unit VI Body Loads:** Idealized structure - Structural surface - shear panel method - Symmetric & asymmetrical vertical loads in a car - longitudinal loads - Different Loading situations.

### **References:**

1. Powloski, J.; Vehicle Body Engg. Business books Ltd
2. Giles J.C; Body construction & Design; Butter worth & Co.
3. Ramalingam KK; Automobile engineering; Scitech pub
4. John Fenton; Vehicle Body Layouts & analysis, Mechanical Engg. Publication Ltd. London.
5. Braithwaite, J.V.; Vehicle Body building & Drawing, Heinemann Edn. Books Ltd. London.

### **List of Experiments (Please Expand it):**

1. To find out forces and moments acting on vehicle body
2. Study of body construction of various vehicles
3. Study and analysis of wind loads on vehicle body
4. Study effect of body materials and painting on vehicle dynamics



**AU- 805 Major Project****Objectives of the course Minor/Major Project are:**

- To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
- To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.
- To adapt students for latest development and to handle independently new situations.
- To develop good expressions power and presentation abilities in students.

The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

**Working schedule** The faculty and student should work according to following schedule:

Each student undertakes substantial and individual project in an approved area of the subject and supervised by a member of staff. The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty.

Action plan for Major Project work and its evaluation scheme #(Suggestive)

Task/Process	Week	Evaluation	Marks For Term Work#
Orientation of students by HOD/Project Guide	1st	-	-
Literature survey and resource collection	2nd	-	-
Selection and finalization of topic before a committee*	3rd	Seminar-I	10
Detailing and preparation of Project (Modeling, Analysis and Design of Project work	4th to 5th	-	10
Development stage			
Testing, improvements, quality control of project	6th to 10th 11th	-	25
Acceptance testing	12th	-	10
Report Writing	13th to 15th	-	15
Presentation before a committee (including user manual, if any)	16th	- Seminar-II	30

\* Committee comprises of HOD, all project supervisions including external guide from industry (if any)

# The above marking scheme is suggestive, it can be changed to alternative scheme depending on the type of project, but the alternative scheme should be prepared in advance while finalizing the topic of project before a committee and explained to the concerned student as well.

NOTE: At every stage of action plan, students must submit a write up to the concerned guide:

**AU- 806 Fault Diagnosis & Trouble Shooting**

**List of Experiments (Please Expand it):**

Diagnosis and trouble shooting of faults generally occurring with light and heavy vehicles and engines