



SYLLABUS  
SCHOOL OF DISTANCE EDUCATION  
ANDHRA UNIVERSITY, VISAKHAPATNAM.  
**B.E./B.TECH. - MECHANICAL ENGINEERING**  
**III<sup>rd</sup> Year**  
**DDMEC-301: INSTRUMENTATION & CONTROL**  
**SYSTEMS**

**Unit-I :**

**Introduction:** Control Systems, Feedback and its effects. Transfer Function, Block Diagram and Signal Flow Graph: Impulse response and Transfer functions of linear systems, Block diagrams.

**Unit-II:**

**Mathematical Modeling of Physical Systems:** Equations of electrical networks, Modeling of mechanical system elements, Equations of mechanical systems, Sensors and Encoders in control systems, DC motors in control systems, State-variable Analysis of Linear Dynamic Systems: Matrix representation of state equations, State transition matrix, State transition equation, Relationship between state equations and high order differential equations, Transformation to phase-variable canonical form, Relationship between state equations and transfer functions, Characteristic equation, Eigen values and Eigen vectors.

**Unit-III:**

**Time-Domain Analysis of Control Systems:** Typical test signals for the time response of control systems, Time-domain performance of control systems. The steady-state error, Time-domain performance of control systems. Transient response, Transient response of a second-order system, Time-domain analysis of a print wheel control system. Effects of adding of poles and zeros to transfer functions. Dominant poles of transfer functions. Stability of control systems – Systems-

Stability, Characteristics equation and the state transition matrix, Methods of determining stability of linear control systems, Routh – Hurwitz criterion.

#### **Unit–IV:**

**Frequency-domain Analysis of Control Systems:** Introduction, Nyquist stability criterion, Application of the nyquist criterion, Effects of additional poles and zeros of  $G(s)$  ( $H$ ) on the shape of the nyquist locus, Stability of multi loop systems, Stability of linear control systems with time delays, Frequency-domain characteristics,  $M_{p1}$   $W_p$  and the bandwidth of a second-order system. Effects of adding a zero to the open-loop transfer function, Effects of adding a pole to the open-loop transfer function, Relative stability - Gain margin, Phase margin and  $M_p$ .

#### **Unit–V:**

**Instrumentations:** Concepts of measurements static performance characteristics accuracy of measurement and its analysis. Instrumentation for Measurement: Force and torque, Stress and Strain, Pressure, Flow, Temperature, Vibration, Pollution.

#### **Textbook:**

1. Automatic Control Systems by B.C.Kuo.
2. Mechanical Measurements by R.S.Sirohi, H.G.Radha Krishna, Wiley-East, N-Delhi.

#### **References:**

1. Experimental Methods for Engineers by J.P.Holman, McGraw-Hill.
2. Instrumentation for Engineering Measurements by R.H.Cerni & L.E.Foster, J.Wiley & Sons, New York.
3. Mechanical & Industrial Measurement by R.K. Jain, Khanna Pub., Delhi.

### **DDMEC-302: Industrial Engineering and Management**

#### **Unit–I:**

**Concepts of Industrial Management:** Principles of management–Growth of management thought, Functions of management, Principles

of organization, Types of organisation and committees. Introduction to personnel management–Functions, Motivation, Theories of motivation, Hawthorne studies, Discipline in industry, Promotion, Transfer, lay off and discharge, Labour turnover, Industrial relations Trade unions, industrial disputes, Strikes, Lock-out, Picketing Gherao, Settlement of Industrial disputes, Collective bargaining, Industrial dispute act 1947 and factories act 1948.

### **Unit–II:**

**Production Planning and Control:** Types of productions. Production cycle, Product design and development, Process planning Forecasting, Loading, Scheduling, Dispatching, Routing, Progress, Control, Simple Problems.

### **Unit–III:**

**Plant Layout:** Economics of plant location, Rural Vs Suburban sites, Types of layouts, Types of building, Travel chart technique, Assembly line balancing simple problems. Materials Handling–Principles, Concept of Unit load, Containerisation, Palletisation, Selection of material handling equipment, Applications of belt conveyors, Cranes, Forklift trucks in industry, Plant Maintenance–Objective and types.

### **Unit- IV :**

**Work Study :** Concept of productivity (Simple problems), Method Study- Basic steps in method study, Process chart symbols, Charts, Diagrams and Models used, Principles of motion economy, Therblings, Simo chart, Work Measurement-Stop watch procedure of time study, Performance rating and allowances, Work sampling, Simple problems.

### **Unit - V:**

**Materials Management:** Introduction, Purchasing, Objectives of purchasing department, Buying techniques, Purchase procedure, Stores and material control, Receipt and issue of materials, Store records, Quantity Control – Inventory, Functions of inventory, Simple EOQ model, ABC analysis, Simple problems. Quality Control – Single and Double sampling plans. Control charts of variables and attributes (Use of formulae only).

**Textbook :**

Industrial Engineering Management by Dr. O.P. Khanna.

**Reference:**

1. Principles of Management by Koontz & Donnel.
2. Production and Operations Management by Everette Adam & Ronald Ebert.
3. Operations Management by John McClain & Joseph Thames.

**DMMEC-303: Thermal Engineering****Unit – I :**

First law of thermodynamics – Corrolories – First law applied to flow processes – Second law of thermodynamics – Kelvin Plank and Classius statements – Reversibility and irreversibility – Classius theorem and Classius inequality – Concept of entropy – Entropy of gases and vapours – Availability and irreversibility – Maxwell’s equations – Tds relations – Joule-Kelvin effect – Classius Chaperon equation – Vanerwall’s equation of state.

**Unit-II :**

Properties of steam and use of steam tables and Mollier chart- Carnot cycle-Rankine cycle-Reheat and regenerative cycles-Binary vapour power cycle-Steam nozzles-Flow through nozzles – Condition for maximum discharge-Relationship between area, velocity.

**Unit-III:**

Classification of steam turbines-Impulse and reaction turbines-Compounding of steam turbines-Velocity diagrams-Blade speed ratio for maximum blade efficiency-Degree of reaction-Governing of steam turbines. Rotary compressors-Centrifugal compressor and Axial flow compressor-Velocity diagrams-Surging and choking-Stalling in A.F.Compressors – Performance characteristics.

**Unit- IV :**

Gas turnbines–Closed and open cycle gas turbines-Ideal cycle-

Efficiency & work ratio-Option compression ratio for maximum efficiency max. specific work output-Polytropic efficiency & adiabatic efficiency-Inter-cooling, Reheating-Regeneration, Combustion-in S.I.&C.I engines-Knocking-in-S.I. & C.I. engines-Factors-effecting-knocking & control-of knocking.

### **Unit-V:**

Refrigeration-Air Cycle refrigeration-Bel Coleman cycle vapour compression refrigeration-Effect of suction and condensing temperatures-Multiple compressors, evaporators and expansion valve systems-Basics of vapour absorption refrigeration-Principles of psychometry-Psychometric terms and processes-Psychometric chart-Types of Air conditioning – Heating and cooling loads – Bypass factor and sensible heat factor.

### **Textbooks:**

1. Engineering-Termodynamics, by P.K.Nag.
2. Thermal-Engg, by D.B.Spalding & Col

### **References :**

1. Refrigeration and Air-conditioning, by Arora and Domkundwar.
2. I.C. Engines, by M.L.Mathur and R.P. Sarma.
3. Thermodynamics, by D.B. Spalding & Cole.

## **DMMEC-304: Theory of Machines – II**

### **Unit-I:**

**Gyroscopic Couple and Precessional Motion;** Precessional and Angular motion – Gyroscopic Couple – Effect of Gyroscopic couples on an aeroplane and on a naval ship, stability of a four wheel vehicle moving in a curved path, stability of a two-wheel vehicle taking a turn. Cams; Classification of followers and cams-Definitions-Motions of the follower -Uniform velocity-Simple harmonic motion-Uniform acceleration & retardation-Displacement-Velocity and acceleration diagrams. Construction of cam profiles-Cam with knife edged follower and roller follower – Cams with specified contours-Tangent cam with

roller follower – Circular arc cam with flat faced follower. Kinematic Synthesis of Mechanisms;

### **Unit–II:**

**Toothed gearing:** Classification of toothed wheels, technical terms, conditions for constant velocity ratio of toothed wheels-Law of gearing-Velocity of sliding of teeth, forms of teeth – Length of contact, arc of contact, interference in involute gears, minimum number of teeth required on pinion to avoid interference-Methods of avoiding interference-Helical gears, Spiral gears – Efficiency of spiral gears. Gear Trains: Types of gear trains-Simple, Compound, Reverted and Epicyclic gear trains-Velocity ratio of epicyclic gear train gear trains.

### **Unit–III:**

**Balancing of Rotating and Reciprocating Masses:** Balancing of several masses revolving in the same plane – Balancing of several masses revolving in different planes – Primary and secondary unbalanced forces of reciprocating masses, Partial balancing of unbalanced primary forces in a reciprocating engine, Partial balancing of locomotives-Variation of tractive force, Swaying couple and hammer blow-Balancing of primary and secondary forces in multi cylinder in-line engines-Direct and reverse cranks-Balancing of V-Engines.

### **Unit–IV :**

**Vibrations:** Definitions–Types of vibrations–Natural frequencies of free longitudinal vibrations of systems having single degree of freedom–Equilibrium method–Energy method and Rayleigh’s method. Frequency of damped vibration and forced vibration with damping– Magnification factor or dynamic magnifier.

### **Unit – V:**

**Transverse and Torsional Vibrations:** Natural frequency of free transverse vibrations due to point load and uniformly distributed load acting over a simply supported shaft-Transverse vibrations for a shaft subjected to number of point loads– Energy methods– Dunkerley’s method. Critical speed of a shaft. Natural frequency of free torsional

vibrations– Free torsional vibrations of singlerotor system,tworotor system,threerotor system&gear system.

**Textbook:**

1. Theory of Machines by R.S. Khurmi and J.K.Gupta.
2. Chapter-IV-from-Mechanism&Machine Theory by J.S. Rao.& R.V.Dukkipati.

**Ref.:**

1. Theory of Machines by Thomas Bevan.
2. Theory of Machines by W.G. Green.

**DDMEC-305: Design Of Machine Elements**

**Unit– I :**

**Fundamentals of Design:** Basic concepts of design procedure, Materials, Properties and their selection and standards, Heat treatment for mechanical design, Stress and deflection analysis, Design stress, Factor of safety and stress concentration factors. Relevance to manufacturing methods, Production aspects of design, statistical considerations in design, Theories of failure.

**Unit – II :**

**Fasteners and Fastenings:** Design concepts of fasteners, Pin-cottered, screwed, riveted, welded and bonded joints, keys-splines.

**Unit – III:**

**Power Transmitting systems:** Spur–Helical–Bevel gears–worm wheel– -belts, ropes and chain drives.

**Unit–IV:**

**Force Transmitting Elements:** Shafts–Power screws–Closely coiled helical compression and tension Leaf springs.

**Unit–V :**

**Miscellaneous Machine parts:** Engine parts like–Cylinder head, Piston, Connecting rod – Crank shaft–Valve mechanism–Fly wheel – Crane hook – C-clamp, Screw jack.

**Textbook:**

Machine Design by R.K.Jain.

**Ref.Books:**

1. Mechanical Engineering Design by J.F.Shigley.
2. Machine Design by N.C. Pandya & C.S. Sha.

**DDMEC : 306 - OPERATIONS RESEARCH****Unit-I:**

**Development:** Definition, Characteristics and Phase of Scientific Method, Types of models, General methods for solving operations research models. Allocation: Introduction to linear programming formulation, graphical solution, Simplex method, Artificial variable technique, Duality principle.

**Unit-II:**

**Transportation Problem:** Formulation optimal solution, Unbalanced transportation problems, Degeneracy. Assignment problem, Formulation optimal solution, Variations, i.e., Non-square ( $m \times n$ ) matrix-restrictions.

**Sequencing:** Introduction, Terminology, Notations & assumptions, problems with  $n$ -jobs and two machines, optimal sequence algorithm, problems with  $n$ -jobs and three machines, problems with  $n$ -jobs and  $m$ -machines, graphic solutions. Travelling salesman problem.

**Unit-III:**

**Replacement:** Introduction, Replacement of items that deteriorate when money value is not counted and countered placement items that fail completely, i.e., group replacement. Waiting Lines: Introduction, Single-Poisson arrivals, Exponential service times, Unrestricted queue with infinite population and finite population models, Single channel poisson arrivals. Exponential service times with infinite population and restricted queue. Multi channel, Position arrivals, Exponential service times with infinite population and unrestricted queue.

## **Unit – IV:**

**Inventory:** Introduction, Single item, Deterministic models, Production is instantaneous or at a constant rate shortages are allowed or not allowed and withdrawals from stock is continuous, Purchase inventory model with one price break. Shortages are not allowed, Instantaneous production direct production or purchase cost is relevant – Shortages are not allowed. Instantaneous production direct production or purchase cost is relevant – Stochastic models. Demand may be discrete variable or instantaneous production. Instantaneous demand and no setup cost.

## **Unit – V :**

**Theory of Games:** Introduction-Minimax (Max criterion and optimal strategy solution of games with saddle points, Rectangular games without saddle points. Notion of Dynamic Programming: Elements of project scheduling by CPM and PERT.

### **Textbooks :**

1. Operation Research by TAHA.
2. Operations Research Methods and Problems by M. Sasiene, A. Yespal and L. Friedman.
3. O.R. by S.D. Sharma.

## **DMMEC-307 : ADVANCED FOUNDRY AND WELDING TECHNOLOGY**

### **Unit-I:**

**Moulding:** Development of metal castings–Materials for moulding– Foundary sand control-Different types of cores-Core making process– Materials for core making–Moulding and core making machines, Recent developments in cores mould making–Cold set process– Investment process–Shell moulding–Hot box method–Shaw process. Vacuum moulding– moulding for mass production.

### **Unit-II:**

**Melting and Solidification:** Furnaces used in foundry for melting ferrous and nonferrous metals – Design of cupola and its charge calculations. Family of cast irons – Production of malleable and S.G.

Irons –Methods of alloying and inoculants and their effects on the structure and properties of cast iron. Principles of Solidification: Nucleation – Crystal growth–Morphology and structure of cast metals and alloys – Pure metals – Single phase alloys and eutectics, Solidification in sand and chill moulds.

### **Unit–III:**

**Foundry Mechanisation:** Layout for ferrous and nonferrous foundries–Description of equipment used for mechanization–Sand conditioners–Conveyors–Cranes–Equipment for handling moulds, Cores and molten metal–Knock out of moulds–Fettling equipment.

### **Unit–IV :**

**Special Welding Processes:** Forge welding–Resistance welding processes–Spot, Seam, Projection, Flash butt welding–Cold pressure welding–Machine cycle for resistance welding – Parameters in resistance welding – Electrodes.

### **Unit–V :**

**Welding Design-Weldability of Metals and Tests :** Factors influencing weldability of metals-Welding of carbon steels, High Tensile steels, Stainless steels, Cast steels, special alloy steels and cast iron. Weldability of cu. Al. and its alloys-Ni and its alloys-Mg and its alloys-Temperature changes in welding and their effects on mechanical properties. Absorption of gases by welds and their effects-Residual stresses and distortion-Heat treatment of welded parts. Welding Design: Gas welding and arc welding processes-Welding symbols-Joint design and its effect on cost and transmission of stresses.

### **Textbooks:**

1. Foundry Technology by Jain P.L.
2. Welding and Welding Technology, by Little.

### **References:**

1. Foundry Engineering by Agarwal.
2. Foundry Engineering by TaylorF. & Others.
3. Welding Technology by Koenisburger.
4. Principles of Metal Castings by Heine & Others.

**DMMEC 308**  
**INDUSTRIAL ENGINEERING LAB**

**List of Experiments:**

1. To measure the skill and dexterity in the movement of Wrist and Fingers using pin board.
2. To measure the Heart beat using Stethoscope.
3. To show that the sample means from a normal universe follow a normal distribution.
4. To draw the control chart for fraction defective for a given lot of marble balls.
5. To determine the cycle time using PMTS.
6. To draw two handed process charts for
  - i. Bolt, Washer and nut assembly
  - ii. Assembly of electric tester.
7. To study the changes in heart rate for different subjects using Tread mill.
8. To draw Multiple Activity chart using an electric toaster.
9. To determine the percentage utilization using work sampling,
10. To study the process capability of a given process.
11. To measure the Heart rate during working and recovery periods of the subjects under different loads, using Bicycle ergometer.
12. To draw flow process charts on activities in Workshop/Laboratory/Office.
13. To determine the time required to perform motion sequence using work factor system.
14. To draw SIMO charts for
  - i. Ball point pen assembly
  - ii. Electric plug assembly.
15. To conduct time study of the bulb holder assembly operation of the existing method.
16. To collect the anthropometries data using 'Anthropolometer'.

**DMMEC 309**  
**MECHANICAL ENGINEERING LAB-II**  
**(Machines Lab)**

**List of Experiments:**

01. To determine the ratio of angular speeds of shafts (driver and driven) connected by Hook's joint.
02. To draw curves of slider displacement and crank angle and linear velocities w.r.t. time for a slider crank mechanism and compare with theoretical values.
03. To determine the ratio of times and ram velocities of Whitworth quick return motion mechanism
04. To determine the relation of gyroscopic couple and compare with theoretical values.
05. To verify the laws of balancing for rotating masses
06. To determine the speed ratios for the given auto gear box
07. Load test on I.C. Engines.
08. To determine the pressure distribution around a cylinder kept in a uniform flow Wind tunnel.
09. Heat balance sheet on engines.
10. Efficiencies of compressor.
11. To draw the crank angle vs. pressure diagram for I.C. engine using pressure transducer and cathode ray oscilloscope.

**DMMEC 310**

**Fluid Mechanics, Hydraulic Machines & Systems Lab**

**List of Experiments:**

01. Calibration of flow meters: a) Venturi meter, b) Orifice meter, c) Nozzle meter
02. Determination of coefficient of discharge for: a) Small orifice, b) Cylindrical Mouth piece
03. Finding coefficient of discharge for: a) Rectangular notch, b) Triangular notch, c) Trapezoidal notch
04. To draw the performance characteristics of Centrifugal Pump
05. To draw the performance characteristics of Reciprocating Pump
06. To find the specific speed of: a) Pelton turbine, b) Francis turbine
07. To draw the pressure distribution and finding coefficient of drag for: a) Bluff body, b) Aero foil
08. To draw the characteristic curves for the hydraulic ram