# E.G.S. PILLAY ENGINEERING COLLEGE

**(Autonomous)**

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

Accredited by NAAC with 'A' Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

## B.E. MECHANICAL ENGINEERING

**Third Year – Fifth Semester**

| Course Code | Course Name | L | T | P | C | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ES | Total |
| **Theory Course** | | | | | | | | |
| 1701MA502 | Operations Research | 2 | 2 | 0 | 3 | 40 | 60 | 100 |
| 1702ME501 | Heat and Mass Transfer | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 1702ME502 | Computer Aided Design | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 1702ME503 | Design of Transmission Systems | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| | Elective I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Elective II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Laboratory Course** | | | | | | | | |
| 1702ME551 | Heat Transfer Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 1702ME552 | Computer Aided Design Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 1704ME553 | Mini Project I (Design and Fabrication) | 0 | 0 | 2 | 1 | 100 | - | 100 |
| 1704GE551 | Life Skills: Aptitude I | 0 | 0 | 2 | 0 | 100 | - | 100 |

**L – Lecture | T – Tutorial | P – Practical | CA – Continuous Assessment | ES – End Semester**

| 1701MA502 | OPERATIONS RESEARCH | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 2 | 0 | 3 |

**UNIT I INTRODUCTION TO LINEAR PROGRAMMING (LPP) 9 Hours**

Introduction to Applications of Operations Research in functional areas of Management. Linear Programming-Formulation, Solution by Graphical and Simplex methods (Primal - Penalty, Two Phase), Dual simplex method. Principles of Duality.

**UNIT II TRANSPORTATION AND ASSIGNMENT MODELS 9 Hours**

Transportation Models – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods. Solution by MODI-Assignment Models- Solution by Hungarian method-Travelling Salesman problem.

**UNIT III NETWORKS AND INVENTORY MODELS 9 Hours**

Scheduling by PERT and CPM - Inventory Models – EOQ and EBQ Models (With and without shortages), Quantity Discount Models.

**UNIT IV GAME THEORY AND REPLACEMENT MODELS 9 Hours**

Game Theory-Two person Zero sum games-Saddle point, Dominance Rule, Methods of matrices, graphical and LP solutions. Replacement Models-Individuals replacement Models (With and without time value of money) – Group Replacement Models.

**UNIT V QUEUING THEORY MODELS 9 Hours**

Queuing Theory - single and Multi-channel models – infinite number of customers and infinite calling source. (M/M/1):( ∞/FCFS), (M/M/S):( ∞/FCFS), (M/M/1):( N/FCFS), (M/M/S):( N/FCFS)- Simple Problems.

**TOTAL: 45 HOURS**

**FOR FURTHER READING/SEMINAR/CBS**

1. Sensitivity analysis, Transshipment problems.
2. Decision making under uncertainty, IPP.

**REFERENCES:**

1. Hamdy A Taha, Introduction to Operations Research, Pearson, 9th Edition, 2014.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.
3. G. Srinivasan, Operations Research – Principles and Applications, PHI, 2007.
4. Kalavathy S, Operations Research, Second Edition, Vikas Publishing House, 2004.
5. N. D Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 2010.
6. nptel.ac.in/courses/112106134/1

| 1702ME501 | HEAT AND MASS TRANSFER | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |

**UNIT I CONDUCTION 12 Hours**

Basic concepts - Mechanism of Heat transfer. Conduction - Fourier's Law, General differential equation in Cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spherical systems. Composite Systems. Extended surfaces – Transient heat conduction Use of Heisler chart.

**UNIT II CONVECTION 12 Hours**

Basic Concepts - Heat transfer coefficients, boundary layer concept. Types of convection - Forced convection, dimensional analysis, non-dimensional numbers, external flow, flow over plates, cylinders and spheres, internal flow, laminar and turbulent flow, combined laminar and turbulent. Free convection - Dimensional analysis, flow over vertical plate, horizontal plate.

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12 Hours**

Modes of boiling - Nusselt's theory of condensation, types of condensation - correlations in boiling and condensation. Heat exchangers - Types, heat exchanger analysis, fouling factor, LMTD (Logarithmic mean temperature difference) and Effectiveness - NTU (number of transfer units) Method - Overall Heat Transfer Coefficient.

**UNIT IV RADIATION 12 Hours**

Laws of Radiation- Stefan-Boltzmann Law, Kirchhoff's Law - Black body radiation - Grey body radiation - Shape factor algebra - Radiation shields.

**UNIT V MASS TRANSFER 12 Hours**

Basic concepts - Diffusion mass transfer - Fick's law of diffusion, Steady state molecular diffusion. Convective mass transfer, momentum, heat and mass transfer analogy, convective mass transfer correlations

**TOTAL: 60 HOURS**

**FOR FURTHER READING/SEMINAR/CBS**

Numerical methods in heat conduction - Finite difference formulation of differential equation, two dimensional steady state heat conduction.

**REFERENCES:**

1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International private limited, New Delhi, 2017.
2. Yunus A. Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2017.
3. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2011.
4. Frank P. Incropera, Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2016.
5. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2009.
6. http://nptel.ac.in/courses/112108149

| 1702ME502 | COMPUTER AIDED DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9 Hours**

Product cycle, Sequential and Concurrent Engineering, CAD - Architecture, Tools, applications - Coordinate systems - Two and Three Dimensional Transformations - Translation - Scaling - Rotation, Windowing - clipping and Viewing.

**UNIT II GEOMETRIC MODELING 9 Hours**

Representation of curves - Hermite, Bezier, B-Spline and rational curves - Surface Modeling - surface patch - Bezier and B spline surface. Solid Modelling - Boundary representation and Constructive Solid Geometry.

**UNIT III VISUAL REALISM 9 Hours**

Hidden line removal algorithm - Priority and Area oriented algorithms. Hidden Surface removal algorithm - Depth buffer and Warnock's algorithms. Hidden solid removal algorithm, Ray Tracing algorithm, Shading and Coloring - types.

**UNIT IV ASSEMBLY OF PARTS 9 Hours**

Assembly modeling - Interference of Positions and orientations - CAD Tolerance Analysis - geometrical Mass Properties - degrees of freedom - Constraints and Simulation concepts.

**UNIT V DATA EXCHANGE FORMATS 9 Hours**

Database Management System - CAD Standards File types - IGES, PDES, Database - Structures - Types, STEP Files. Communication Standards - File Transfer between CAD and CAM package.

**TOTAL: 45 HOURS**

**FOR FURTHER READING/SEMINAR/CBS**

Graphics manipulation and Editing - Parametric Representation of Synthetic Curves

**REFERENCES:**

1. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.
2. Ibrahim Zeid“Mastering CAD/CAM”, McGraw Hill Book Co. Singapore, 1989.
3. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
4. Donald Hearn and M. Pauline Baker “Computer Graphics””. Prentice Hall, Inc, 1992.
5. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.
6. http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Computer%20Aided%20Design%20&%20ManufacturingI/index.htm

**1702ME503 DESIGN OF TRANSMISSION SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 2 | 0 | 4 |

**UNIT I DESIGN OF FLEXIBLE ELEMENTS 12 Hours**

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

**UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 12 Hours**

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears

**UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 12 Hours**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

**UNIT IV GEAR BOXES 12 Hours**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

**UNIT V CAMS, CLUTCHES AND BRAKES 12 Hours**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

**TOTAL: 60 HOURS**

**FOR FURTHER READING/SEMINAR/CBS**

**REFERENCES:**

1. Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, 2008.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
4. Sharma C S, Kamlesh Purohit, “Design of Machine Elements”, Prentice Hall of India, Pvt. Ltd., 2003.
5. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”, 2nd Edition, Tata McGraw-Hill Book Co., 2006.
6. http://nptel.ac.in/courses/108102047/

| 1702ME551 | HEAT TRANSFER LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**LIST OF EXPERIMENTS:**

| | | |
|---|---|---|
| 1. | Determination of thermal conductivity of insulating powder. | **4 Hours** |
| 2. | Determination of thermal conductivity of guarded hot plate. | **4 Hours** |
| 3. | Determination of thermal conductivity of materials in lagged pipe. | **4 Hours** |
| 4. | Determination of heat transfer co-efficient through composite wall. | **2 Hours** |
| 5. | Determination of heat transfer co-efficient by natural convection. | **2 Hours** |
| 6. | Determination of heat transfer co-efficient by forced convection. | **2 Hours** |
| 7. | Determination of heat transfer co-efficient in a parallel and counter flow heat exchanger. | **2 Hours** |
| 8. | Determination of heat transfer co-efficient and effectiveness from Pin-Fin by natural | **2 Hours** |
| 9. | Determination of heat transfer co-efficient and effectiveness from Pin-Fin by forced | **2 Hours** |
| 10. | Determination of Stefan-Boltzmann constant. | **2 Hours** |
| 11. | Determination of emissivity using emissivity apparatus. | **2 Hours** |
| 12. | Determination of performance in a fluidized bed cooling tower | **2 Hours** |

**Total: 30 Hours**

| 1702ME552 | COMPUTER AIDED DESIGN LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**3D GEOMETRIC MODELLING**

**LIST OF EXPERIMENTS:**

1. Introduction of 3D Modelling software
2. Create the part model of mechanical components

**Creation of 3D assembly model of following machine elements using 3D Modelling software**

1. Flange Coupling
2. Plummer Block
3. Screw Jack
4. Universal Joint
5. Machine Vice
6. Stuffing box
7. Safety Valves
8. Non-return valves
9. Connecting rod
10. Piston
11. Crankshaft
12.

**Total: 30 Hours**

* Students may also be trained in manual drawing of some of the above components

| 1704ME553 | MINI PROJECT I (Design and Fabrication) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**GUIDELINE FOR REVIEW AND EVALUATION**

The students may be grouped into 2 to 4 and work under a project supervisor. The device / system / component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

**Total: 30 Hours**

| 1704GE551 | LIFE SKILLS: APTITUDE – 1 | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**UNIT I INTRODUCTION TO NUMBER SYSTEM, BASIC SHORTCUTS OF ADDITION, MULTIPLICATION, DIVISION** **6 Hours**

Classification of numbers – Types of Numbers - Divisibility rules - Finding the units digit - Finding remainders in divisions involving higher powers - LCM and HCF Models - Fractions and Digits – Square, Square roots – Cube, Cube roots – Shortcuts of addition, multiplication, Division.

**UNIT II RATIO AND PROPORTION, AVERAGES** **6 Hours**

Definition of Ratio - Properties of Ratios - Comparison of Ratios - Problems on Ratios - Compound Ratio - Problems on Proportion, Mean proportional and Continued Proportion Definition of Average - Rules of Average - Problems on Average - Problems on Weighted Average - Finding average using assumed mean method.

**UNIT III PERCENTAGES, PROFIT AND LOSS** **6 Hours**

Introduction Percentage - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions - Problems on percentages - Problems on Profit and Loss percentage- Relation between Cost Price and Selling price - Discount and Marked Price - Two different articles sold at same Cost Price - Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price.

**UNIT IV CODING AND DECODING, DIRECTION SENSE** **6 Hours**

Coding using same set of letters - Coding using different set of letters - Coding into a number - Problems on R-model - Solving problems by drawing the paths - Finding the net distance travelled - Finding the direction - Problems on clocks - Problems on shadows - Problems on direction sense using symbols and notations.

**UNIT V NUMBER AND LETTER SERIES NUMBER AND LETTER ANALOGIES, ODD MAN OUT** **6 Hours**

Difference series - Product series - Squares series - Cubes series - Alternate series - Combination series - Miscellaneous series - Place values of letters - Definition of Analogy - Problems on number analogy - Problems on letter analogy - Problems on verbal analogy - Problems on number Odd man out - Problems on letter Odd man out - Problems on verbal Odd man out.

**TOTAL: 30 HOURS**

**REFERENCES:**

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
4. R S Agarwal, 'Quantitative Aptitude for Competitive Examinations', revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

**ASSESSMENT PATTERN:**

1. Two tests will be conducted (25×2) - 50 marks.
2. Five assignments will be conducted (5×10) - 50 marks.

| 1703ME001 | NON - TRADITIONAL MACHINING PROCESSES | L | T | P | C |
|---|---|---|---|---|---|
| | (Common to B.E / B.Tech-All branches) | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION 6 Hours**

Introduction - Need - Classification - Energies employed in the processes - Brief overview of Abrasive jet machining(AJM), Water jet machining(WJM), Ultrasonic machining(USM), Electric discharge machining(EDM), Electro-chemical machining(ECM), Electron beam machining(EBM), Laser beam machining(LBM), Plasma arc machining(PAM).

**UNIT II MECHANICAL ENERGY BASED PROCESSES 9 Hours**

Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining - Working Principles, Equipment, Process parameters, Material removal rate, Applications.

**UNIT III ELECTRICAL ENERGY BASED PROCESSES 12 Hours**

Electric Discharge Machining - Working Principles, Equipment, Process Parameters, Material removal rate, Electrode / Tool, Power Circuits, Tool Wear, Dielectric, Flushing, Wire cut EDM - Applications.

**UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9 Hours**

Chemical machining - Etchants, Maskants - techniques. Electro-chemical machining - Working principle, Equipment, Process Parameters, Material removal rate, Electrical circuit. Electro-chemical grinding - Electro-chemical honing - Applications.

**UNIT V THERMAL ENERGY BASED PROCESSES 9 Hours**

Laser Beam machining, Plasma Arc Machining - Principles, Equipment. Electron Beam Machining - Principles, Equipment, Types, Beam control techniques, Material removal rate - Applications.

**TOTAL: 45 HOURS**

**FOR FURTHER READING/SEMINAR/CBS**

Abrasive water jet machining, Electric discharge grinding and drilling, Electro-stream drilling, Electro-chemical deburring. Mechanical Contour machining, Whirling jet machining. Ion beam machining and Hot chlorine machining.

**REFERENCES:**

1. P. K. Mishra, Non Conventional Machining, Narosa Publishing House, New Delhi, 2007.
2. P. C. Pandey and H.S. Shan, Modern Machining Processes, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2008.
3. Joao Paulo Davim, Nontraditional Machining Processes: Research Advances, Springer, New York,2013.
4. Vijaya Kumar Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi, 2005.
5. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Professional, New delhi, 2005
6. http://nptel.ac.in/courses/112105126/36 (Non Traditional Manufacturing)

| 1703ME006 | WELDING TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I GAS AND ARC WELDING PROCESSES 9 Hours**

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.

**UNIT II RESISTANCE WELDING PROCESSES 9 Hours**

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

**UNIT III SOLID STATE WELDING PROCESSES 9 Hours**

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

**UNIT IV OTHER WELDING PROCESSES 9 Hours**

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

**UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9 Hours**

Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments.

**TOTAL: 45 HOURS**

**FOR FURTHER READING/SEMINAR/CBS**

Case studies- Application of underwater welding and explosive welding.

**REFERENCES:**

1. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.
2. R. S. Parmer, Welding Processes & Technology, Khanna Publishers, New Delhi, 2008.
3. O. P. Khanna, A text book of Welding Technology, Dhanpatrai publications, Second Edition - New Delhi, 2002.
4. Metals Hand Book, Volume 6, American Society for Metals, 2005.
5. Sindokou, Welding metallurgy, A Jhon wiley & sons,Inc. Publication, Second Edition-New Jersey, 2003.
6. www.weldingtypes.net .