

Course Code	ME – 8001	Credits : 4	L-3, T-1, P-0
Name of the Course	COMPUTER AIDED DESIGN		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Section – A

Fundamental and Hardware in CAD: Introduction; the Design Process; The Application of Computer for Design; Creating the Manufacturing Data Base; Benefits of CAD; The Design Work Station; The Graphics Terminal; Operator Input Devices; Plotters and other Output Devices; The Central Processing Unit; Secondary storage.

Principles of Computer Graphics and Graphical Techniques; Graphical Primitives; Point Plotting; Drawing of lines – DDA Algorithm; Bresenham's Circle Algorithm; Ellipse, Scan Conversion – Real Time Conversion, Run Length Encoding, Cell Encoding, Frame Buffers, Rendering, Rasterising Polygons – Scan Converting Polygon, Seed Fill Algorithm; Hidden Surface Removal – Z buffer Algorithm, Antialiasing; Reflection; Shading; Generation of Characters; View Port; Pointing; Positioning Rubber Banding, Dragging; Clipping; Positioning of Text; Menu and Menu Alternatives; Graphics User Interface; Parts of Window Screen; Type of Windows.

Section – B

Two and Three Dimensional Transformations: Transformation of Point, Straight Line & Parallel Lines; Mid – Point Transformation; Rotation; Reflection; Scaling; Combined Transformation; Square and Slid body Transformation; Three Dimensional Scaling; Shearing, Rotation, Reflection and Translation; Multiple Transformation; Rotation about an Axis Parallel to a Co-ordinate Axis; Orthographic Projection; Problems.

Plane and Space Curves: Curve Representation; Non – Parametric Curves; Parametric Representation of a Circle, Ellipse, Parabola, Hyperbola: Representation of Space Curve; Cubic Splines; Problems.

Section – C

Surface Description and Generation: Surfaces of Revolution, Sweep Surfaces, Quadric Surfaces, Piecewise Surface Representation, Mapping Parametric Surfaces, Bilinear Surface, Ruled and Developable Surfaces, Cone Surfaces, Beizer Surfaces Problems.

Design and Drawing Using 2D & 3D Wire Frame Modeling Packages: Introduction Geometric & Wire Frame Modeling; 2D & 3D Wire Frame Models Hardware for Drafting Packages; Command and Menu Driven softwares; Features of a Drafting Package; Drawing Utilities, Entities; Edit commands, Blocks and Symbols; Display/View; Cross Hatching.

Section – D

Solid Modeling and Design Data Base: Scheme for representation Solid Objects – Pure Primitive Instancing, Special Occupancy Enumeration, Cell Decomposition, Constructive solid Geometry (CSG), Boundary Representation (B-Rep), Hybrid Schemes; Procedure for Creation of Solid Models, using Solid Models, using Solid Modeling Package: Data Base-Concept, Objectives, Structures, Design Considerations.

Text Books:

- CAD/CAM (Theory & Pactice) by Ibrahim – Zeid Published by Tata McGraw Hill, New Delhi.
- Mathematical Elements for computer Graphics by David F. Rogers and J. Alan Adams, Published by McGraw Hill, New Yrk.

Reference Books:

- CAD/CAM (Principles, Practice & Manufacturing Management) by Chris McMohan & Jimmie Browne, Published by Addison – Wesley.
- AutoCAD14 for Engg. Drawing Made Easy by P.Nageshwara Rao, Published by Tata McGraw Hill, New Delhi.
- Computer Graphics & Design by P.Radhakrishnan and G.P.Kothandaraman, Dhanpat Rai Pub.(Pvt.) Ltd., New Delhi.
- CAD/CAM by Mikell P. Groover and Emory W.Zimmers, Jr. ublished by Pentice Hall of India, New Delhi.

SEMESTER – VIII

POWER PLANT ENGINEERING

ME – 8002

Course Code	ME – 8002	Credits : 4	L-3, T-1, P-0
Name of the Course	POWER PLANT ENGINEERING		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Section- A

Introduction: Energy resources and their availability, Types of power plant, selection of the plants, review of basic thermodynamics cycles used in power plant.

Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating power plants, design, construction and operation of different components of hydro-electric power plant, site selection, comparison of other types of power plants.

Section- B

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Gas Turbine Power Plants: Types, open and closed gas turbine, work output & thermal efficiency, methods to improve thermal efficiency of gas turbine plant- reheating, inter-cooling regeneration & their combinations, advantage and disadvantages, comparison with steam power plant, problems.

Section- C

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear power station, trouble shooting and remedies.

Power Plant Economics: Effect of plant type on costs, fixed elements, energy elements, customer elements and investor's profit, depreciation and replacement.

Section- D

Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors OTEC, wind power plants, geothermal resources.

Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle thermoelectric power generation, thermionic power generation.

Text Books:

- Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat- Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Power Plant Engineering: P.K. Nag Tata McGraw Hill second Edition 2001.

Reference Books:

- An Introduction to Power Plant Technology by G.D. Rai-Khanna Publishers, 2-B, Nath Market, Nai Sarak, Delhi-110005
- A Course in Power Plant Engineering by Arora and Domkundwar – Dhanpat Rai and Co. Pvt. Ltd., New Delhi.
- Power Plant Engineering : M.M. El-Wakil McGraw Hill 1985

Course Code	ME – 8003	Credits : 4	L-3, T-0, P-0
Name of the Course	ENTREPRENEURSHIP DEVELOPMENT		
Lectures to be delivered	39 (1 Hr Each) (L = 39, T = 0 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	Max. Marks: 50		

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Section- A

Entrepreneurship: Entrepreneurship, Role of entrepreneurship in Indian economy, Characteristics of entrepreneur, Types of entrepreneurs, some myths and realities about entrepreneurship.

Small scale industries: Introduction, Role and scope of small scale industries, concept of small scale and ancillary industries undertaking, How to start a small scale industry, Steps in launching own venture, procedure for registration of small scale industries, various development agencies-their functions and role in industrial and entrepreneurship development, infrastructure facilities available for entrepreneurship development in India.

Section- B

Product planning and Development: Introduction, Requirement of a good product design, product development approaches, Product development process, Elements of concurrent engineering, quality function development, Rapid prototyping, Various controlling agencies involved; their role and formalities for getting clearance before starting individual venture.

Section- C

Preparation of feasibility Project Report: Tools for evolution of techno economic feasibility project report, SWOT analysis.

Section- D

Elements of Marketing & Scales Management

Nature of product and market strategy, packing and advertising, after sales service, social responsibility and business ethics.

Important Legal Provisions

Sales of good act, partnership act, packing and advertising, after sales service, social responsibility and business ethics.

Text Books:

- The practice of Entrepreneurship – G.G. Meredith, R.E. Nelson and P.A. Neek
- Handbook of Entrepreneurship – Rao and Pareek

Reference Books:

- Engineering Economics - Tarachand
- Industrial Engineering and Management - Ravi Shanker
- Industrial Engineering and Management - O.P. Khanna – Dhanpat Rai & Sons, NewDelhi.

SEMESTER – VIII

COMPUTER AIDED DESIGN LAB

ME - 8005

Course Code	ME – 8005	Credits : 2	L-0, T-0, P-3
Name of the Course	COMPUTER AIDED DESIGN LAB		
Lectures to be delivered	39 hours of Lab sessions		
Semester End Examination	Max. Time = 3 hrs.	Max. Marks : 50	Min. Pass Marks: 20
Laboratory	Continuous Assessment (based on Lab work 30%, Lab record 25%, Viva 25%, Attendance 20%)	Max. Marks: 50	Min. Pass Marks: 25

Instructions for paper setter/Candidates

Laboratory examination will consist of two parts:

- i) Performing a practical examination assigned by the examiner (25 marks).
- ii) Viva-voce examination (25 marks).

Viva-voce examination will be related to the practicals performed/projects executed by the candidate related to the paper during the course of the semester.

List of Experiments:

1. Implement line drawing and circle drawing algorithm.
2. Write a program to create perspective and orthographic projections of 3.D Objects.
3. To create 2-D and 3-D wire frame models of a bracket/spur gear on drafting package. Auto CAD/PROENGINEER/I-DEAS.
4. To create cubic splines and Bezier spline curves for given control point.
5. To create the surface of a diffuser section of Tunnel/propeller on solid Modeller/ Auto CAD/PROCENGINEER/I-DEAS
6. To create solids e.g. cube with a hole, gear blank etc using constructive solid geometry Auto CAD/PROENGINEER/I-DEAS.
7. To create solids e.g. cube with a hole, gear blank etc. using boundary representation on no gap between Auto CAD – Auto CAD/PROENGINEER/ I-DEAS.

At Least Six Experiments should be preformed from the above list. Remaining One Experiment designed and set by the concerned Institution as per the scope of the syllabus.

SEMESTER – VIII
ENTREPRENEURSHIP DEVELOPMENT LAB

ME - 8007

Course Code	ME – 8007	Credits : 2	L-0, T-0, P-2
Name of the Course	ENTREPRENEURSHIP DEVELOPMENT LAB		
Lectures to be delivered	26 hours of Lab sessions		
Semester End Examination	Max. Time = 3 hrs.	Max. Marks : 50	Min. Pass Marks: 20
Laboratory	Continuous Assessment (based on Lab work 30%, Lab record 25%, Viva 25%, Attendance 20%)	Max. Marks: 50	Min. Pass Marks: 25

Instructions for paper setter/Candidates

Laboratory examination will consist of two parts:

- iii) Performing a practical examination assigned by the examiner (25 marks).
- iv) Viva-voce examination (25 marks).

Viva-voce examination will be related to the practicals performed/projects executed by the candidate related to the paper during the course of the semester.

List of Practical:

1. Familiarization to entrepreneurship and its development in India.
2. Collect the data from nearby existing small scale industries.
3. Analysis of data and their different aspects.
4. Suggestions, recommendation, improvements for the plant.
5. To prepare the project report
6. Case – Study

SEMESTER – VIII

MAINTENANCE ENGINEERING

ME-8010

Course Code	ME – 8010	Credits : 4	L-3, T-1, P-0
Name of the Course	MAINTENANCE ENGINEERING		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

SECTION A

Introduction: Evolution of maintenance, objective of maintenance, maintenance and philosophies, maintenance concept maintenance management & technology, relationship with other functional areas, importance of maintenance, elements of good maintenance economics of maintenance, training and safety aspects in maintenance.

Maintenance strategies; classification of maintenance programs. Corrective, preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance concept, functions, benefits, limitations.

SECTION B

Condition based maintenance (CBM); Objectives, what to monitor, when to monitor principal of CBM, condition based maintenance techniques, manual inspections performance monitoring, vibration monitoring, oil debris. Spectroscopy thermography and corrosion, monitoring steps in implementation of CBM, benefits of CBM.

Reliability Centered maintenance (RCM): RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM methodology, evaluation and benefits,

SECTION C

Non-destructive Testing (NDT): Purpose and challenges; techniques, visual aids boroscopes, endoscopes fiber optics scanner, magnetic particles inspection, liquid penetrants. Ultrasonic radiography, selection of NTD techniques, merits/demerits and application of various techniques.

Maintenance Planning and Control: Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance productivity areas for improvement.

SECTION D

Reliability; maintenance & availability techniques for improvement of operation reliability, safety and availability of machines and production system, maintainability criteria, checklist to assess the maintainability improvement program, fault diagnosis, pareto principle, ishikawa diagram.

Text books:

- Maintenance planning and control – Higgin L.R. McGraw Hill book company 1988.
- Maintenance planning and control – Kelley Anthony, East-West Press Pvt. Ltd.

Reference books:

- Maintainability principal and practices Blanchard B.S. Lowey E.E. Mc Graw Hill.
- Practical NDT – Raj B, Jayakumar T, Thavasimutyi K, Narora Publishing House.
- Engineering Maintenance Management – Nieble Benjamin W, Marcel Dekker.

Course Code	ME – 8011	Credits : 4	L-3, T-1, P-0
Name of the Course	ROBOTICS ENGINEERING		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

SECTION A

Robotic manipulation: Automation and Robots Classification – Drive Technologies Work-Envelope Geometries, Motion Control Method, Application: Robot Specifications – No. of Axes, Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision, Accuracy, Operating Environment, An Example; Rhino X-3.

SECTION B

Direct kinematics the arm equation homogenous Co-ordinates – frames, translation and rotations, composite homogenous transformations, screw transformations, link Co-ordinates; the arm equation; a five-axis articulated robot; a four-axis scara robot; a six-axis articulated robot; problem.

Inverse kinematics: Solving the arm equation: the inverse kinematics problem general properties of solutions; tool configuration; inverse kinematics of a five-axis articulated robot, four-axis scara robot, six-axis articulated robot and three-axis planar articulated robot; A robotic work cell problems.

SECTION C

Work space analysis and trajectory planning; work space analysis; work envelope of a five axis articulated robot, work envelope of a four axis scara robot, work space fixtures, The pick and place Operation, Continuous path motion, Interpolated motion, straight line motion problem.

Differential motion and statics: the tool configuration jacobian matrix; joint space singularities; generalised inverses; resolved motion rate control; $n > 6$; rate control of redundant robots: $n > 6$: rate control using (1)–inverse, the manipulator jacobian; induced joint Torques and forces problem.

SECTION D

Manipulator dynamics: Lagranges equation; kinetic & potential energy; generalized force; lagranges euler dynamic model; dynamic model of a two axis planar articulated robot and a three axis scara robot; direct & inverse dynamic recursive Newton – euler formulation; dynamic model of a one axis robot; problem.

Robot control: the control problem; state equations; constant solutions; linear feedback system; single axis PID control; PD gravity control; computer – torque control; variable structure control; impedance control; problem.

Text Books:

- Fundamental of robotics (analysis & control) by Robot J. Schilling Published by PHI, Pvt. Ltd., New Delhi.
- Introduction to Robotics (Mechanics & control) by John J.Craig Published by Addition Wesley (intl. student edition).

Reference Books:

- Analysis robotics & mechatronics by wolfram stadler Published by Mc-Graw Hill inc New Delhi.
- industrial robotics – technology programmer & application by mikell P grover weiss nagel and ordef published by Mc-Graw Hill international edition.
- A robotics Engg. Text book – mohsen shahinpoor, harper & Low publishing New York.
- Robotics principal & Practice by K.C. Jain Aggarwal, Khanna Publishers, Nai Sarak, Delhi.
- Robotics Engg.- An integrated approach Richard D.K Klafter. Thomas A. Chmielewski and Michael PHI 1989.
- Foundations of robotics analysis and control – Tsuneo yashikawa MIT press 1990.indian reprint 1998.
- Robots and control – R.K. Mittal and Nagrath – Tata McGraw Hill 2003.

SEMESTER – VIII
ERGONOMICS AND WORK PLACE DESIGN

ME-8012

Course Code	ME – 8012	Credits : 4	L-3, T-1, P-0
Name of the Course	ERGONOMICS AND WORK PLACE DESIGN		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions

- 1. For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- 2. For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

SECTION A

Basic Principal of ergonomics: introduction to ergonomics; anthropometry, Posture and health; anthropometry practical; display, control and HMI; tools and equipment design; work place design and assessment; task analysis; questionnaire and interview design product design and evaluation; designing for manufacture; health and safety legislation and ergonomics.

SECTION B

Application of ergonomics principal; cognitive ergonomic; human information processing; memory; reading; perception; Navigation; problem solving; decision making; human computer interaction; input/output technology; usability; evaluation; health problem; future system, job design, scientific management, enrichment, equipment Rotation cells, shift work, management style and job design, change management.

SECTION D

Case Studies: set case studies will be used to demonstrate how ergonomics has lead to changes in work activity, safety and product design case studies will include advanced computer application, workplace assessment and re-design, accident analysis and industrial inspection, and in manufacturing. Students will be required to apply the principal to a real life ergonomics design as applied to a product, service or computer application.

Text Books:

1. Work design industrial ergonomics – knoz Stephan A. Johnson steven. Holcomb Hathaway Scottsdale, AZ.
2. Human factors in engineering and design Sanders M.S. & McCormick E.J (1987), 6th ed, McGraw Hill New York.

Reference Books:

1. Ergonomics man in his working environment Murrell, K.F.H. (1965) Champan & Hall London.
2. Man – Machine engineering chapanis A wordsworth Publishing , Co.
3. The practice and management of industrial erginimics Alexander D.C.(1986), Prentice-hall Englewood chiffs NJ.
4. Textbook of work Physiology Astrand, P.O. Rhodahl, K. (1986) 3rd ed. – McGraw Hill, New York.
5. Human Factors in Lighting – Boyce P.R.(1981).Macmillan, New York.
6. The Ergonomics of Workspaces and Machines : A design manual – Clark, T.S. & Corlett, EN.(1984), Taylor & Francis, London.
7. The worker at work : A textbook concerned with men and women in the workplace, Fraser, T.M.(1989) Taylor & Francis, London.
8. Ergonomics at work, Osborne, D (1987) Wiley, London.

Course Code	ME – 8013	Credits : 4	L-3, T-1, P-0
Name of the Course	MODERN MANUFACTURING PROCESSES		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	Max. Marks: 50		

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

SECTION – A

Mechanical Processes: Ultrasonic Machining – Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitation of the process, advantages and disadvantages. Abrasive Jet Machining – Variables in AJM, metal removal rate in AJM. Water Jet Machining – Jet cutting equipments, process details, advantages and applications.

SECTION – B

Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining – Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical grinding – Material removal, surface finish, accuracy, advantages, applications.

SECTION – C

Thermal Metal Removal Processes: Electric Discharge Machining (EDM) of spark erosion machining processes, mechanism of metal removal, spark erosion generators, electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection, applications. Wire cut EDM, Laser beam machining (LBM) – Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations.

SECTION – D

Plasma arc Machining (PAM): Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C.plasma torch unit, safety precautions, economics, other applications of plasma jets. Electron beam Machining (EBM) – Generations and control electron beam, theory of electronic beam machining, process capabilities and limitations.

Text Books:

- Modern Machining Processes – P.C.Pandey, H.S.Shan, Tata McGraw Hill Publishing Company Limited.
- Machining Manufacturing Science – Ghosh and Malik, Affiliated East – West Press.

Reference Books:-

- Non Traditional Manufacturing Processes – Benedict G.F.Macel Dekker.
- Advanced Methods of Machining – Mc Geough J.A., Chapman and Hall.

Course Code	ME – 8019	Credits : 4	L-3, T-1, P-0
Name of the Course	ADVANCED OPERATIONS RESEARCH		
Lectures to be delivered	52 (1 Hr Each) (L = 39, T = 13 for each semester)		
Semester End Examination	Max. Time: 3 hrs.	Max. Marks: 100	Min. Pass Marks: 40
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)		Max. Marks: 50	

Instructions

- For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
- For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

SECTION – A

Introduction to Operations Research

Formulation of problems, simplex method problem of degenerals, dual simplex method revised simplex method, bounded variable problems.

Integer Programming

Graphical method, the branch and bound technique, Gomory's ALL-IPP method, transportation model, unbalance in transportation, transshipment problem, sensitivity analysis in transportation problems.

SECTION – B

Dynamic Programming

Bellman's principle of optimality, examples on the application on routing problem, inventory problem, simplex problem, marketing problem.

Network Analysis

PERT and CPM, probability of achieving completion data, cost analysis, graph reduction theory, updating, resource allocation, resource smoothing.

SECTION – C

Inventory Method:

Variables in an inventory problem, inventory problem, inventory models with penalty, storage and quantity discount, safety stock, inventory models with probability, demand, multi item deterministic model.

Queuing Theory

Poisson arrivals and exponential service times, waiting time and idle time cost, single channel multi channel problem. Monte technique applied to queuing problems, Poisson arrivals and service time.

SECTION – D

Decision Theory Game

Examples on the application of theory of games 2 XM and MX2 Problems, graphic dominance and linear programming method for different problems, decision trees.

Replacement Models

Replacement of items that deteriorate, gradually, fail suddenly, group placement policy, concept of system reliability.

Text Books:

- ❖ Kumar Gupta, Prem and Hira, D.S., "Operations Research", S Chand & Company Limited, 1986.
- ❖ Swarup, Kanti, Gupta, P.K. and Manmohan, "Operations Research", Sultan Chand & Sons, New Delhi 1988.
- ❖ Srinath L.S., "PERT & CPM Principles and Applications", Affiliate East West Press (P) Limited, New Delhi, 1975.

SEMESTER-VIII**CRYOGENIC ENGINEERING****ME-8014**

Course Code	CS-8014	Credits:4	L-3, T-1, P-0
Name of the Course	CRYOGENIC ENGINEERING		
Lectures to be delivered	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max.Time: 3 hrs.	Max Marks:100	Min.Pass Marks: 40
Continuous Assessment (based on sessional tests 50 % , Tutorials Assignments 30%, Quiz/Seminars 10% Attendance 10%)	Max.Marks:50		

1. For paper Setters: The question paper will consist of five sections A,B,C,D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B,C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. For Candidates: Candidates are required to attempt five questions in all selecting one question from each of the sections A,B,C,D, of the question paper and all the subparts of the questions in Section E. Use of Non-programmable calculators is allowed.

Section-A

Introduction: Limitations of vapour compression systems for production of low temperature, multistage systems, cascade system, production of solid carbon dioxide, magnetic cooling.

Low Temperature Thermometry: temperature scales gas-vapour pressure thermometry, adiabatic demagnetization.

SECTION-B

Cryogenic Gases: Properties of cryogenic fluids-oxygen, nitrogen, air, hydrogen and helium Joule-Thomson effect and liquefaction of gases, liquefaction of air, hydrogen and helium, critical components of liquefiers, reftifier columns, separation of air, separation of helium from natural gas, distillation of liquid hydrogen & purification.

SECTION-C

Insulation: Vacuum insulation, gas filled powders and fibrous materials, solid forms, comparison of various insulating materials.

Storage: Types of insulated storage containers, various design considerations, safety aspects- flammability hazards and high pressure gas hazards.

SECTION-D

Transportation: Two phases flow, transfer thorough insulated and uninsulated lines, liquid line indicators, pumps and valves for cryogenic liquids.

Applications: Industrial applications, research and development; Mechanical, thermal and thermoelectric properties of structural material at cryogenic temperatures.

Text Books:

1. Cryogenics and refrigeration Coldin.
2. Experimental techniques in low temperature physics G.K.White, Clayrendon Press, Oxford.

Reference:

1. Cryogenic research and applications-Marshall Sitting and Stephen and Kid, D.Van Nostrand Company.Inc.USA.
2. Cryogenics-Bailey C.A
3. Refrigeration and air conditioners-Spark and Dillo.

SEMESTER-VIII

MATERIAL HANDLING AND PLANT LAYOUT

ME-8015

Course Code	CS-8015	Credits:4	L-3, T-1, P-0
Name of the Course	MATERIAL HANDLING AND PLANT LAYOUT		
Lectures to be delivered	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max.Time: 3 hrs.	Max Marks:100	Min.Pass Marks:40
Continuous Assessment (based on sessional tests 50 %, Tutorials Assignments 30%, Quiz/Seminars 10% Attendance 10%)	Max.Marks:50		

1. For paper Setters: The question paper will consist of five sections A,B,C,D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B,C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. For Candidates: Candidates are required to attempt five questions in all selecting one question from each of the sections A,B,C,D, of the question paper and all the subparts of the questions in Section E. Use of Non-programmable calculators is allowed.

SECTION-A

General : Concepts and factors governing plant locations economics, rural economics, rural Vs urban plant sites, case studies (i) Selection of a site for software company(ii) Selection of a site for XYZ Company: analysis of alternatives. Introduction of plant layout, principles and objectives of effective layout, advantages of good layout, symptoms of bad layout. Types of plant layout , their features. Applications and comparison, Introduction to group technology: its relevance, application and advantages.

SECTION-B

Planning the layout: Factors influencing plant layout; material factors, machinery factors, man factors movement factors, waiting factors, service factors, change factors, building factors, workstation design methods of plants and factory layout, plant layout procedure, factory building , building equipments, common problems in plant layout, tool and techniques of layout, operation process chart, flow process chart, flow diagram, string diagram, evaluating alternate layout-various methods.

Line balancing: Objective of line balancing problems; constraint in line balancing problem, terminology in assembly line, preventive measures to achieve a balanced production line.

Types of line balancing: (a) Assembly line balancing (b) Fabrication line balancing, Heuristic and other method of line balancing, simple numerical problems in line balancing.

SECTION-C

Materials handling : Objectives of material handling systems, material handling engineering survey, basic features of handling, types of material handling systems, material handling engineering survey, basic features of handling, various materials handling, considerations including combined handling, space for movements, analysis of handling methods, economical and technical considerations of handling equipment, cost analysis of material handling systems.

SECTION-D

Material handling equipments: Introduction, types of material handling equipment; selection and maintenance of material handling equipments, characteristics of material handling equipments such as conveyers, cranes, hoist, Amount of equipments required and predicting in process inventory by graphical technique.

Travel Chart: Procedure for travel charting, numerical problem on optimum arrangement of various departments of shops under given constraints and to check their effectiveness.

Text Books:-

1. Plant Layuot and design – By Moore.
2. Plant Layout and material handling – By Apple.

Reference Books:-

1. Plant Layout – By Shubhin.
2. Construction Management - Mahesh Verma.

SECTION – A

Compressible Flow: Wave propagation and sound velocity; Mach number and compressible flow regimes; basic equations for one dimensional compressible flow, isentropic flow relations; area velocity relation; normal shock waves, relations between upstream and downstream flow parameters.

SECTION – B

Gas Turbine Systems and Cycles: System of operations of gas turbines – constant volume and constant pressure gas turbines; thermodynamics of Brayton cycle; regeneration – intercooling. Reheating and their combinations; closed cycle and semi closed cycle gas turbines; gas Vs I.C.engines and steam turbines.

SECTION – C

Compressors: Classification – positive displacement and dynamic compressors. Operations of single stage reciprocating compressors, best value of index of compression, isothermal efficiency, effect of clearance and volumetric efficiency, multistage compression, air motors. Centrifugal compressors, static and total head values; velocity vector diagrams; slip factor; pressure coefficient and prewhirl, Axial flow compressors; degree of reactions and polytropic efficiency performance characteristics, surging, choking and stalling.

Combustion System: Types, combustion process, combustion intensity efficiency and pressure loss.

SECTION – D

Air breathing Propulsion Systems: Principle of jet propulsion; analysis and performance characteristics of turbojet, turboprop, ramjet and pulsejet; thrust power and propulsion efficiency.

Rocket Propulsion: Operating principle; solid and liquid propellants, performance analysis calculations for specific impulse and propulsive efficiency.

Text Books:

1. Gas Turbine Theory – Cohen and Rogers.
2. Principle of Jet Propulsion and Gas Turbine – Zucrow M J.

Reference Book: Heat Engineering – Vasandani V P and Kumar D S, Metropolitan Book Co Pvt. Ltd.

SECTION – A

Fuel Cell Technology for Vehicles: What is fuel cell, Type of fuel cell, Advantage of fuel cell. Current state of the technology. Potential and challenges. Advantages and disadvantages of hydrogen fuel.

SECTION – B

Latest Engine Technology Features: Advances in diesel engine technology, Direct fuel injection Gasoline engine. Diesel particulate emission control. Throttling by wire. Variable Valve Timing, Method used to effect variable Valve Timing. Electromagnetic Valves. Camless engine actuation.

42 Volt System: Need, benefits, potentials and challenges. Technology Implications for the Automotive Industry. Technological evolution that will occur as a result of the adoption of 42 volt systems.

SECTION – C

Electrical and Hybrid Vehicles: Types of hybrid systems, Objective and Advantages of hybrid systems. Current status, Future developments and prospects of Hybrid Vehicles.

Integrated Starter Alternator: Starts stop operation, Power Assist. Regenerative braking. Advanced lead acid batteries, Alkaline batteries, Lithium batteries, Development of new energy storage systems. Deep discharge and rapid charging ultra capacitors.

SECTION – D

X-By Wire Technology: What is X-By Wire, Advantage over hydraulic systems, Use of Automotive micro controllers, Types of sensors. Use of actuators in an automobile environment.

Vehicle Systems: Constantly Variable Transmission, benefits, Brake by wire, Advantages over power Braking systems. Electrical assist. Steering, Steering by wire, Advantages of steering by wire. Semi-active and fully active suspension system. Advantages of fully active suspension system.

Text and Reference Books:

1. Advanced Vehicle technologies by Heinz Heisler – SAE International Publication.
2. Electric and Hybrid Electric Vehicles by Ronald K.Jurgen – SAE International Publication.
3. Batteries for Electric Vehicles by DAJ Rand, R.Woods and R.M.Dell – SAE International Publication.
4. Electronics Braking, Traction and Stability Control – SAE Hardboud papers.
5. Electronics steering and suspension systems – SAE Hardboud papers.
6. 42 Volt systems by Daniel J. Holt – SAE International Publication.
7. Diesel Particulate Emission by J. H. Johnson – SAE Hardboud papers.
8. Fuel Cell Technologies for Vehicles by Richard Stobart – SAE Hardboud papers.

SECTION – A

Basic Elasticity: Three dimensional stress and strain systems. Principal stresses, principal strains and Principal planes. Mohr's circle for 3-dimensional stress and strain systems.

Two Dimensional Elasticity: Stress functions, plane stress and plain strain methods.

Torsion: Torsion of circular and elliptical bars – Elastic analysis.

SECTION – B

Introduction to Plasticity: Idealised stress strain systems, approximate equation for stress strain curves (Remberg – Osgood, Ludwing's and Karunes equations), Bausschinger effect-yield locus, yield surface.

SECTION – C

Yield Criteria and Flow Rules: Tresca theory & Von-Mises yield criterion, their geometrical representation, experimental evidence for the criteria.

Slip line field Theory: Two dimensional plasticity, slip lines, basic equations, Hencky's first theorem, Geiringer's Velocity equation, Application of slip line field theory to plane strain problems.

SECTION – D

Load Bounding: The lower bound theorem, the upper bound theorem and their corollaries. Application of load bounding to plane strain problems.

Books Suggested:

1. Plasticity for Mech. Engrs.: Johnson & Miller – Van Nostrand.
2. Exp. Analysis : Dally & Riley.
3. Elasticity : Sokolnikoff.
4. Analysis of stress and strain: Durlli, Phillips – McGraw Hill.
5. Engg. Plasticity: Calladina – Pergaman Press.