VEER NARMAD SOUTH GUJARAT UNIVERSITY

PG DIPLOMA IN CAD/CAM/CAE

Semester-I

Sr. No.	Subject Code	Subject Name	Scheme		Marks	
			L	P	L	P
1	CA 101	Theory of Elasticity and Plasticity.	3	9	100	150
2	CA 102	Finite Element Analysis.	3		100	
3	CA 103	Advanced Computer Aided Manufacturing- I.	3		100	
4	CA 104	Advanced Computer Aided Design.	3		100	
5	CA 105	Product Design and Development.	3		100	
6	CA 106	Project	0	3	0	50
		TOTAL	15	12	500	200

Semester-II

Sr. No.	Subject Code	Subject Name	Scheme		Marks	
			L	P	L	P
1	CA 201	Process Equipment Design and Drawing.	3	9	100	150
2	CA 202	Computer Aided Engineering.	3		100	
3	CA 203	Advanced Computer Aided Manufacturing- II.	3		100	
4	CA 204	Project Management and Quality Standards.	3		100	
5	CA 205	Project	0	6	0	200
		TOTAL	12	15	400	350

Minimum Marks required for passing is 40% in each theory papers, practical and project separately.

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Semester-I

CA 101
THEORY OF ELASTICITY AND PLASTICITY

- Introduction: Review of force, Moment and stresses, force moment equivalents, static equilibrium, general three dimensional case, dynamic force equilibrium, stress strain relation, principal stresses, different theory of failure.
- Elements of theory of elasticity: Stress tensor, Plane stress and plane strain problems, Equilibrium and compatibility equations in Cartesian co-ordinate system. Air's stress function.
- Torsion: Torsion governing equations, Membrane analogy, analysis of elliptical and rectangular section, Torsion of thin walled hollow shafts of circular, Elliptical and rectangular shape.
- Elements of theory of plasticity: Concepts of true stress and true strain, Uniaxial tension of perfect and imperfect strip, Biaxial tension, Floe rules, Experimental strain analysis, Strain gauges, Rossets etc.
- Elementary analysis of creep and thermal stresses. Creep phenomenon, Creep parameters, Stress relaxation, Designing component subjected to creep.

Books

1. Advanced strength of material
   - R.C.Patel
   C.Jamnadas & co.
2. Mechanical Analysis and Design
   - Arthun H. Barr.
   Prentice-Hall of India.
3. Mechanical Engineering Design
   -Joseph E. Shiglay.
   Tata McGraw Hill.
4. Theory of Plasticity
   -J. L. Duncan.

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Semester-I

CA 102
FINITE ELEMENT ANALYSIS

- Introduction to Finite Element Method (FEM): General applicability, Engineering applications, General description of FEM, Comparison of FEM with other methods of analysis, General procedure of FEM, Potential energy and equilibrium, The Relay-Ritz Method, The galerkin's approach.

- One Dimensional Finite Element Analysis (Linear Structural Problem) : Finite Element Modelling of one dimensional problem, Natural co-ordinate system and shape function, stiffness matrix and force terms, Elimination approach, Penalty approach, Multipoint constrains, Quadratic shape function, Temperature effect.

- Two Dimensional Finite Element Analysis (Linear Structural Problem) : Finite Element Analysis of two dimension problem, Constant strain triangles, Isoperimetric relationships, Stiffness matrix, Force term, Stress calculation.

- Finite Element Analysis (Thermal problem) : Finite Element Modelling of steady state thermal problem, Consideration of conduction and convection heat transfer terms, Solution of one dimension problem(fins), Solution of two dimensional problem. Solution of axisymmetric steady state heat transfer problems.

Books

1. The Finite Element Method in Engineering.
   -S.S.Rao.
   B.H.Publication.

2. Introduction to Finite Elements in Engineering.
   -Tirupathi R. Chandrupthla & Ashok D. Belegundu.
   Prentice-Hall India Private Limited.
3. The Finite Element Method
   -Zeinkiewiz O.C.
   Tata McGraw Hill Publication.
4. Applied Finite Element Method.
   -Segerlind L.J.
   John Wiley Publication.

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Semester-I

CA 103

ADVANCED COMPUTER AIDED MANUFACTURIND -I

- CNC Machines : Development of CNC Machines, Principles, Features, Advantages, Economics benefits, CNC and DNC concepts, Classification of CNC machines, CNC controllers, Interpolations. Structure of CNC machine tool, Friction, Antifriction and other types of guide ways, Element used to convert rotary motion to linear motion, Screw and nut, Reticulating ball screw, Planetary roller screw, Re-circulating roller screw, Rack and pinion etc. Drives and controllers, Spindle drives, DC shunt motors, 3 phase AC induction motors, Steeper motor, Servo principal, Axis measuring system, Sync resolver.
- Tooling and Maintenance of CNC Machine: Cutting tool materials, carbide insets classification, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices, maintenance of CNC Machines.
- CNC programming: Introduction to Various CNC part programming techniques, Co-ordinate system, Structure of part programming, Preparatory commands, Miscellaneous Functions, Spindle control, Feed rate control, Tool function, Tool compensation, Linear and circular interpolation, Plane selection, Part Programme for Face milling, Peripheral milling, Turning and Boring operations, Part programming for different control system, G & M code, APT part programming for various machine.
- Introduction to environment of CAM and their process and modelling overview, Tool path generation and tool path planning using Cam Software, Concept of 3-axis, 4-axis, 5-axis CNC machine and their part programming.
- Special types of CNC machines: CNC grinding machine, EDM, Wire EDM, punch press and their part programming using various CAM packages.

Books:

1. HMT- Mechatronics, Tata McGraw-Hill publishing company limited New Delhi.
2. CNC machining handbook, -James Madison, Industrial Press Inc.
3. Introduction to computer numerical control, - Bery Leathan-Jones, Pitman, London.
4. Computer Numerical Control, - Hans B. Kief , T. Fredericxwaters McGraw Hill, New Delhi.
5. Manuals of UGCAM and MASTERCAM

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Semester-I

CA 104
ADVANCED COMPUTER AIDED DESIGN

- Introduction: Application of computers to design, benefits of CAD, conventional design v$_{s.}$ CAD. Standards in CAD, Graphics and computing standards, data exchange standards, design database interfacing design and drafting, Mechanical assembly.
- Introduction to CAD software: Capabilities of various commercially available software in the area of CAD such as IDEAS, Solid Edge etc.
- Solid modelling: Solid modelling, Rapid prototyping, Data exchange, Documentation, Customizing, Solid modelling systems.
- Rapid prototyping: Rapid prototyping systems, Selective laser sintering - Working principles - Advantages and limitations - Sterolithography - Working principle Applications, advantages and limitations - Case studies.
- Other systems, laminated object modelling - Waving principles, applications - Advantages and limitations - Fused deposition modelling - Direct shell production casting - Applications.
- Re-engineering tools and Implementation: Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE-opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability. Introduction to Product Lifecycle Management (PLM) - Concept, Implementation, Case Study.
- **Books**

1. CAD/CAM Theory and Practise,
   -Ibrahim Zeid.
   Tata M$_c$Graw-Hill publishing company limited New Delhi.
2. CAD/CAM principles,
   -P.N.Rao.
   Tata M$_c$Graw-Hill publishing company limited New Delhi.
3. CAD/CAM,
   -Sadhusingh.

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Semester-I

CA 105
PRODUCT DESIGN AND DEVELOPMENT

- Introduction: Nature and scope of product engineering, creative thinking and organizing for product innovation criteria for product success in life cycle of product success in life cycle of a product.
- Modelling and simulation: Modelling and simulation- the roll of models in product design mathematical modelling.
- Design considerations for: Dies for bulk metal deformation- wire drawing, extrusion, forging and rolling, design of dies for sheet metal: Blanking and piercing, Bending and deep-drawing, design of dies for casting and moulding using CAD packages.
- Tolerance and analysis: Dimensioning and tolerancing a product- functional production and inspection datum-tolerance analysis.
- Material selection: Material selection, Problems of material selection, Performance characteristics of materials, the material selection process, Economics of materials, cost verses performance relations, weighted property index.

Books

6. Design Methods.
   -J.C.Jons.
   Interscience.
7. Creative Engineering Design.
   -H.R.Buhl.
   Lown State University Press.
8. Engineering Design.
   -G.E.Dieter.
   McGraw-Hill Publications.
9. Tolerance Control in Design and Manufacturing.
   -O.R.Wade.
   Industrial Press.

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Semester-II

CA 201
PROCESS EQUIPMENT DESIGN AND DRAWING

- Introduction of pressure vessels and its various components with the latest available design code of construction.
- Mechanical Design Basics and its applications. Various criteria of design using elastic-plastic theory, fatigue and creep ruptures.
- Design of vessels under various internal and external loadings i.e.: internal pressure, external pressure, wind/seismic loads, piping loads, thermal loads & cyclic loads.
- Selections of various pressure vessel components i.e., head, skirt, nozzle & pipes based on different loadings.
- Selection of different materials of pressure vessel as per various code of construction.
- Overview of the ASME design code for design criteria, selection of material and construction details.
- Understanding of the various stresses in the pressure vessel i.e., stresses in cylindrical shells, heads, external rings, discontinuity stresses at different geometry, thermal stresses, general and localized stresses, primary and secondary stresses, stresses due to fatigue and creep phenomenon.
- Design of storage vessel, storage of non-volatile and volatile liquids and gases, codes for storage vessel design, bottom and shell designs.
- Design of various columns i.e., distillation, fractionation, depropenisation.
- Design of special high-pressure vessel.
- Design of heat exchangers, shell and tube heat exchangers, tube sheet channels, shell joints, baffles, tie rods, expansion provisions.
- Design of various supports on vertical and horizontal vessels.
- Process hazards & safety measures and design of pressure relief valves.

- Evaluation of pressure vessel in various mode of fabrication like, erection, hydro test and heat treatment.
- Overview of the fabrication techniques and welding processes.

DRAWING

- Fabrication drawing preparation and understanding for pressure vessels, tanks, columns & heat exchangers.
- Drawing preparation of various components of pressure vessel such as heads, skirt, nozzles, flanges, elbows, spools, trays, chimneys, external & internal supports.
- Drawing of various components of heat exchanges like tube-sheets, baffles, tie rods, trays, nozzles & flanges, external supports.

BOOKS :

1. M. V. Joshi, ‘ Process Equipment Design’, McMillan Co. India, 1976.
2. L. E. Brown, E. H. Young, ‘Process Equipment Design’, Wiley Eastern Ltd., New Delhi. 1977.
3. B. C. Bhattacharya, ‘Introduction to Process Equipment Design’.
4. Denis Moss
5. Javed & Farr, ‘Structural …….& design of process equipment’
6. W. C. Young, ‘Roarks’ Formula for stress & strain’
7. E. F. Megyesy, ‘ pressure vessel handbook’
8. TEMA

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Semester-II

CA 202
COMPUTER AIDED ENGINEERING

- Introduction: Fundamentals of modelling to do CAE, Generating FEM models, Understanding of nodes, elements & element matrix, Use of different types of meshing, Implications of material properties and physical properties in mesh creation, Know mapped mesh and free mesh, Difference of shell and solid mesh.
- Boundary Conditions: Boundary condition creation, Define various load and other related parameters considering application and requirement, Use of symmetric/axi-symmetric boundary conditions
- Solutions: Different types of analysis and its applications, Different solvers and its use. Results interpretation and comparison, Acceptable Criteria, Allowable limits as per various codes and standards, Actual stress and displacement comparison.
- Axisymmetric solids subjected to axisymmetric loading: Introduction, Axisymmetric formulation, Finite element modelling: Triangular elements, Problem modelling and boundary conditions etc.
- Non linear analysis: Nonlinear finite element in design, Lagrangian and eulerian finite elements in one dimension- governing equations for total Lagrangian formulation, weak formulation for total Lagrangian, finite element discritization in total Lagrangian, elements and global matrices, governing equations for updated Lagrangian formulation, weak formulation for updated Lagrangian formulation, finite element discritization and elements and global matrices for updated Lagrangian formulation, Continuum mechanics, Lagrangian meshes, Constitutive models- stress-strain curve, 1-D elasticity, nonlinear elasticity,
- Basic concepts of Finite Element Analysis for different type of analysis such as, Buckling analysis, Contact analysis, Optimization etc.

Books

1. Software User Manual
2. Software Tutorial Guide
3. Design by Analysis – Pressure Equipment Directive

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Semester-II

CA 203
ADVANCED COMPUTER AIDED MANUFACTURING - II

- Introduction to CNC turning operations, Part programme for turning cycles, pattern of holes, taper turning, Grooving and parting off operation, knurling operation, single point threading operation, Four-axis lathes
- Introduction to CNC Milling operations, Part programme for slots-pockets and planner milling, helical milling, thread milling, standard and rigid taping operation, Programming with taper end mills.
- Part programming for special features like Gears (Helical, spur), cam profiles etc., part programme for horizontal machining centre.
- Advanced part programming: Polar co-ordinates, Parameters, Looping and Jumping, Subroutines, Mirror imaging and Scaling, coordinate rotation, Special canned cycles and Fanuc Macros.
- Integrated Manufacturing System: Definition - application - features - types of manufacturing systems-machine tools-materials handling system-computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - Artificial Intelligence in CIM.

Books

1. CAD/CAM principles, -P.N.Rao, Tata McGraw-Hill publishing company limited New Delhi.
2. CNC Programming Techniques,- Peter Smid, Industrial Press Inc.
3. FANUC CNC custom macros, - Peter Smid, Industrial Press Inc.

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Semester-II

CA 204
PROJECT MANAGEMENT AND QUALITY STANDARDS

- **Introduction:** Foundations of Project Management, Project Life Cycle, Project Environment, Project Selection, Project Proposal, Project Scope, Work Breakdown Structure, documentation.
- **Project Monitoring, Control and Costing:** Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT Modeling, Time-cost Trade-offs, Estimation of Project Costs, Monitoring Project Progress, Project Appraisal and Selection, Recent Trends in Project Management, Introduction to project management software.
- **Quality Systems:** Introduction to ISO, TQM and 6σ, Quality Systems Standards,Quality functions & functions-various definitions such as quality function, quality measurement, quality costs. Quality in production, design, marketing etc. Quality conduit, SQC, quality assurance, total quality control,TQM- Introduction, history, principles, Quality policy, Quality system, Quality management, TQM system & models, Essentials of TQM, ISO 9000 quality management system, ISO 9000 elements, applications and benefits. Zero defect. Implementation registration & certification for ISO 9000, Case studies on TQM.

Books

- LIPTAK: Process Control Handbook
- ANDREWS: Applied Instrumentation in Process Industries
- TAPAN BAGCHI: ISO-9000 Concepts, Methods and Implementation, WHEELER
- ISO-9000 Guidelines for the process industries
- N. LOGO THETIS, “Managing for total quality”-Prentice Hall of India Pvt. Ltd.-1997.
- JOEL E. ROSS, “Total Quality Management”-Varity Book International, New delhi-1995.
- S.M. SUNDAVA RAJU, “Total Quality Management”-Tata Mc Graw Hill Publishing Co. P. Ltd, New Delhi-1995.
- A.N.SINGH, “reparation, Implementation & Registration of ISO 9000 Quality System”- Dolphin Books, New Delhi-1993.