Choice Based Credit System Syllabus
(w.e.f. June 2015-16)

SOLAPUR UNIVERSITY, SOLAPUR

M.E.Mechanical (Manufacturing Process) Engineering

Part I

SEM – I

Sr. No.	Name of the subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Advanced Manufacturing techniques- I	3	2	25	100	--	125
2	Electro Physical Processes	3	2	25	100	--	125
3	Computer Aided Manufacturing	3	1	25	100	--	125
4	Reliability & Terotechnology	3	1	25	100	--	125
5	Elective I	3	1	25	100	--	125
6	Seminar I	--	2	25	--	--	25
Total		15	9	150	500	--	650

L-Lecture, T/P-Theory/Practical, T/W- Term Work, TP - Theory Examination

SEM – II

Sr. No.	Name of the subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Advanced Manufacturing techniques - II	3	1	25	100	--	125
2	Robotics & Robot Applications	3	2	25	100	--	125
3	Manufacturing Process Modeling	3	2	25	100	--	125
4	Machine Tool Engineering	3	1	25	100	--	125
5	Elective - II	3	1	25	100	--	125
6	Seminar - II	--	2	25	--	--	25
7	Mini Project	--	--	--	--	--	--
Total		15	9	150	500	--	650

*Mini project should be completed during vacation after Semester II & report is to be submitted in Semester III

Elective - I

1. Composite Materials
2. Design For Manufacturing
3. Management of Technology
4. Database Management System

Elective - II

1. Total Quality Control
2. Finite Element Methods
3. Tribology
4. Computational Techniques

Part II

Sem - III

Sr. No.	Name of the subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1.	Mini Project	--	--	50	--	--	50
2	Seminar III	--	1	--	--	50	50
3	Dissertation Phase I	--	4	50	--	--	50
Total		--	5	100	--	50	150

Sem - IV

Sr. No.	Name of the subject	Teaching Scheme		Examination			Total Marks
		L	T/P	T/W	TP	ORAL	
1	Dissertation	--	5	200	--	100	300
Total		--	5	200	--	100	300

SEMESTER – I

1. ADVANCED MANUFACTURING TECHNIQUES – I

Teaching - 3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical - 2 Periods (60 min.each) per week. Term work - 25 Marks

1) Advances in Non- Conventional Processes:

Process Principle, parameters, applications and special features of AFM, ECD, ECG, WJM, MAF, Chemical machining, automation of NCMPs

2) Advanced Welding Process:

Friction, Explosive welding, under water welding, submerged Arc Welding, thermal analysis of heal-affected zone (MAZ), NDT. Methods of measuring welding defects by Radiographs, Ultrasonic flow detector and metallurgical analysis to prevent-premature failure. Atomic emission spectrometer, Residual stress analysis in Welding

3) Rapid Prototyping and Rapid tooling:

Sterolithography, FDM, SLS, SLA) LOM. Product Development Cycle and importance of Prototyping and Generative manufacturing process Precision fine blanking process, Elasto Plastic analysis by Press Brake deep drawing.

4) Coat Technology:

PVD, CVD, Electro less technology, Plasma Spraying, Coating of Epoxy based materials to prevent corrosive and erosive wear. Plasma coating of ceramic powders and polymeric powders. Coating tribology. Of crating

Term work:

The term work consists of assignments and the case studies based on above syllabus

References: -

1. “Manufacturing Processes": B.H.Amstead, PhilipF, Ostwald and Myron L, Begeman, John Wiley and sons, eighth edition.
2. “Advanced Manufacturing Processes": G.F.Benidict, Marcel Deker Publisher
3. “Manufacturing Analysis", N. Cook.
4. “Non-traditional Machining Process": Weller, SME Publications.
5. “Non-Conventional Machining Process: P. K. Mishra, Narosa publication.
6. “H.MT Hand book"- Production Technology.
7. “Machining Data Hand Book" , -
8. "Metals Hand Book"
9. "Rapid prototyping process": Amitabh Ghosh.
10. "Rapid prototyping: principles & applications in manufacturing: Chua chee Kai, Leong Kah Fai John Wiley & sons

2. ELECTRO PHYSICAL PROCESSES

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

- Principle, MRR theory, process parameters and Process characterization.
- Micro Machining: EDM with Ultrasonic process, laser & electron beam, electrochemical machining & grinding, AJM, USM, EDM, WEDM, ECDM
- Thermo chemical machining, ECM with ultrasonic vibration.

Term work: Minimum four assignments based on above syllabus.

References:

1. "Non-traditional manufacturing process" by Garry, Marcel Dekker.
2. "Non-traditional Machining process" by E.L.Weller.
3. "Non-conventional machining process" by P.K.Mishra.
4. "Manufacturing analysis" by N.Cook.

3. COMPUTER AIDED MANUFACTURING

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Introduction

Productivity Vs Flexibility, Hard & Soft automation. Basic ideas in NC, CNC, DNC, Machining Center, FMS (Flexible Manufacturing System), FMC (Flexible Manufacturing Cell), and Shop floor control.

2. Group Technology (GT)

Coding and classification, production flow analysis/Group Layout/Benefits of GT, Cellular Manufacturing and Cell formation by Rank Order Clustering (ROC) Method, Similarity Coefficient Meth**od.**

3. Concurrent Engineering-

QFD, DFM, QLF of Taguchi. Process Capability, Process Capability Index, GT. for Concurrent Engineering, Implementation

4. Process Engineering:

Basic machining Calculations process optimization, online process Performance - monitoring & inspection, CAPP.

5. Product data Modeling and Manufacturing information system. Virtual –

Manufacturing, e-manufacturing.

Term work:

It consists of NC, CNC programming and assignments on the basis of above syllabus.

References:

1. "CNC Technology & Programming". Steve Krav & Gill, McGraw-Hill Publishing Company.
2. ".Automation. Production System and Computer Aided Manufacturing". Groover M.P. Prentice Hall of India Ltd.
3. "CAD /CAM / CIM". Radha Krishna P. & Subramanyam S., Wiley Eastern Ltd.
4. "Computer Control of Manufacturing System", Yoran Korcn. McGraw Hill Publishing Company.
5. "CNC". Kief. McGraw-Hill Publishing Company.
6. "Computer aided manufacturing", W.J. Fabri (KY & J.H Mize Prentice Hall - international edition)

4. RELIABILTY AND TEROTECHNOLOGY

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Integrated studies of Reliability and Terotechnology.

Principle and Practices. Life cycle cost significance and various mathematical modeling including simulation.

2. Types of Maintenance:

Breakdown, Preventive, Periodic, and Conditional type Maintenance.
Reliability Center maintenance, TPM. Life cycle cost.

3. Diagnostics and Simulation:

Vibration Signature analysis, Particle analyzer, Spectro-Photometer etc.condition based maintenance and Simulation,

4. Spare Part Management:

Selective inventory control, ordering rules and Inventory policies, MRP approach for maintenance resources planning and control.

5. Reliability, availability, maintainability.

Evaluation of system reliability for various configurations using 1) Star Delta
2) Conditional Probability 3) optimal tie set or cut set method 4) Event analysis.

6. Redundancy, Allocation of Reliability:

AGREE, AR1NC, MATRIX. Mean, Median, methods. Non-parametric Reliability using Variable and attribute methods. Accelerative test of Reliability *using* truncated time and tests.

7. Engineering design Reliability:

Design synthesis/strength/load interaction, iterative designs

8. Fault analysis:

FMEA, FMECA. Criticality through RPN (Risk Priority Number) Digraph and AHP, Ferro graph, terotechnology and tribo analysis, monitoring techniques.HFA.

Term work:

It consists of at least four assignments based on above syllabus.

References:

1. "Reliability Imgineeri.ng" by Kapoor and Lumbcrsom.
2. "Reliability Engineering" by L.S.Srinath.
3. "Terotechnology -Reliability Engineering and Maintenance Management" by Bikas Bhadury & S.K.Basu -Asian Books Pvt., Ltd.
4. "Reliability Engineering and Terotechnology”- A.K.Gupta Mc Millan Co
5. "Reliability' engineering"- by Singh & Dhillon.

5. Electives – I

5.1 Composite Materials

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Introduction:

Introduction to composite materials, basic concepts, constituent materials for composites, advantages, limitations of composites and application of composites.

2. Manufacturing of Composites:

Introduction, molding process for polymer matrix composites, metal matrix composites, ceramic matrix composites.

3. Lamina stress strain relationship:

Introduction, effective modules in stress-strain relationships, symmetry in stress strain relationships, orthotropic and Isotropic engineering constants, specially orthotropic lamina. Generally orthotropic lamina.

4. Lamination theory and analysis:

Introduction, lamination theories strain displacement relationships, laminate classification, types, engineering constraints, and thermoplastic lamination theory.

5. Mechanical testing of composites and their constituents:

Introduction, Measurement of constituent material properties. Measurement of basic composite properties, tensile test, compression test, flexure test, In-plane shear lest, creep less. Vibration lest.

Term work:

It Consist of Six to eight assignments based on above syllabus

References:

1. "Principle of Composite Materials mechanics", R.f.Gibson. McGraw-Hill 1994
2. "Mechanics of Composite materials", R.M. Jones, McGraw-Hill, i975,Tokyo
3. "Mechanics of Fibrous composites". C.T.Herkovich, 1997, John Willy' Publications

5.2 DESIGN FOR MANUFACTUREING

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Product Design Process: -

Importance, design process, steps, concept, design, embodiment design, detail design, planning for manufacture, distribution , use & retirement of product, Consideration of good design, review; redesign; product life cycle, technology Development cycle

2. Principles of DFM:-

Multi -disciplinary, design team; early vs. late design changes, sequential vs. concurrent, design approach; role of processing in design; types of manufacturing processes.

- Early cost estimation approaches, methods Engg, analogy, parametric, cost index, based costing and design to cost
- Process selection and factors influencing the process selection such as cost,
- Lead time, quality," quantity, material, complexity,
- Availability, process selection approaches.
- Importance of material.
- Selection and methods of material selection
- Need of early supplier involvement.

3. Design for Manufacture:

Definition DFM guideline, design for casting, design for -forging, design for machining, design for sheet-metal stamping, design for plastic processing, injection molding, extraction, blow molding, rotational molding, thermoforming, compression, molding. Green design concept, introduction to design for assembly

4. Manufacturability evaluation methods:-

Qualitative &quantitative approaches, knowledge based & feature based manufacturability analysis, multi-criteria approaches like analytic hierarchy IDT Process

5. DFM case studies:-

Term work:

It consists of at least four assignments based on above syllabus.

References:

1. Dieter George E "ENGINEERING DESIGN" 3rd addition Mc Graw Hills Publications 2000.
2. Braela "Design for Manufacturing" Mc Graw Hills Publications 1998.
3. Corbett John and All. "Design For Manufacture: Strategies. Principles and Techniques". Addison-Wesley, 1990.
4. Ettlie S.E and Stoll H.W. Managing the Design-Manufacture Process, Mc Graw Hill.
5. Magrab Edward 13. “Integrated Product and Process Design and Development; The Product realization Process," CRC PRESS. 1997

5.3 MANAGEMENT OF TECHNOLOGY

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. MOT (Management of Technology):

Description scope & implications, Systems & holistic model of MOT. Strategic, Operational and Management issues. Classification of Technologies, technology cycle, I'en basic tents for MOT, Strategic dimension of MOT and role of corporate board. Technological change and traditional strategic management. Strategic architecture for MOT, technology and competitive advantage.

2. Industry Institute Partnership for targeted basic research. Managing technology,-

Based innovations, managing the innovation process, Technovative Company. Patents & intellectual property rights, importance & implications. With, respective international scenario/patent Laws.

3. Technology forecasting:

Approaches, Tech. Performance parameters, Use of experts in tech. Forecasting, Planning tech. Progress. Morphological analysis of a technology system.

4. Technology Transfer:

Definition Source, Model of TT. TT System with public and private enterprises, TT in developing countries using applied research and development inst Steps in TT.

Term work:

At least four assignments based on above syllabus & latest information in the field.

References:

1. "Hand books of Technology Management", Gerard II. "Gus" Gaynor (Editor in Chief). McGraw Hill.
2. "The Management of Intellectual property", Salyawtar Ponkshc, A.bhate & Ponkshe Publications. Pune.
3. "Work books on MOT", I IT.

5.4 DATABASE MANAGEMENT SYSTEMS

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Introduction:

Purpose of data base system, view of data, data models, database languages, transaction management, store management, data base administration, database users, overall system structure.

2. Inter relationship model:

Design issues, mapping constraints, keys, entry relationship diagram, weak entry sets extended for features, design of an E-R data base schema Reduction of an E-R schema to tables.

3. **Relational model**

Structure of relational data base, the relational algebra, the tuple relational calculus, the domain relational calculus, extended relational algebra operations, modification of the data base views.

4. Structured query language (SQL):

Basic structure, set operations, aggregate functions, null values, nested sub queries, derived relations, views, modification of data base joined relation. data definition language, other relational language, query by example quell, data log, views.

5. Integrity constraints:

Domain constraints. Referential integrity, assertions, triggers, functional dependencies views.

6. Relational data base design:

Pitfalls in relational database design, decomposition, normalization, using functional dependencies, views.

7. Object oriented database

New database applications, The object oriented data model, object oriented language, Persistent programming languages, object relational database views, indexing & hashing ordered indices B- Tree index files, static hashing, comparison of ordered indexing & hashing index, definition in SQL views.

8. Query processing analog information for cost estimation

Measure of query cost, selected operation, sorting, join operation, transformation of relational expression views.

9. Transactions:

Transaction concepts, transaction state, implementation of atomicity & durability, concurrent execution, serial ability. Recoverability. Transaction definition in SQL, Testing for serial ability views

10. Database system architectures:

Centralized systems, client server systems, parallel systems, distributed systems, network types, parallel database, distributed data base, security & integrity, standardization views.

11. Expert database systems

Expert database architectures, semantic data model vie**ws.**

12. D.B.M.S. Applications

Decision support system, data analysis, data ware housing geographical databases, multimedia databases, mobility & personal database, information retrieval systems, distributed information systems, the world wide views.

13. Database applications in mechanical engineering. For product design databases-

Data management requirements, databases shop floor control factory information.

Term work:
At least four assignments based on above syllabus & latest information in the field.

References:

1. “Database System Concepts "Abraham Silberschatz, Henry F McGraw Hill
2. "Expert Data Base System a Gentle Introduction" P.Beynon McGraw Mill
3. "Database management System" by lenis Martin
4. DBMS by Gordon devis.

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6. **SEMINAR**

Teaching Scheme:
Tutorial/Practical: 2Hr./week/student Term Work: 25 Marks

The seminar shall consist of study of a particular topic based on 4 to 6 research papers on the case study of industries. The internal marks shall be awarded as the basis of performance of the individual student during his/her seminar presentation. Each student is also required to submit a report based on above study in the prescribed format.

SEMESTER-11

1. ADVANCED MANUFACTURING TECHNIQUES II

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Advanced Casting Processes:-

Process description, Principles, applications, features of investment Casting, Shell mould Casting, Full mould casting. Continuous Casting shape Casting Heal How analysis in Continuous and shape Casting, Casting Defects and remedies, inspections of Casting, Solidification process in casting.

2. **Finishing Processes: -**

Honing, Lapping, Super finishing and burnishing and deburring Processes.

2. Advance Forming Process:-

HERF, Hydro Forming, Explosive forming. Magnetic- Forming Process

Solid Phase Welding and Cold Pressure, welding.

4. Manufacturing of Plastics:-

Plastics: Classification, Binders, Uses etc. Manufacturing of Plastics by different Processes like injection Moulding, transfer Moulding, Blow moulding, Expansion Moulding.

5. Powder metallurgy:-

Important characteristics and methods of powder production, different techniques - pressing, extruding, isostatic moulding, fiber metal process, sintering and hot pressing.

Term work: - It shall consist of assignments and case studies based on above syllabus

References: -

1. “Manufacturing processes" by Amstead Philips Oslwald and Myron I. Begeman, john wiely and sons.
2. "Advanced Manufacturing Processes”, G. f.Bcnidict, Marcel Dekar.
3. “Principle of metal manufacturing processing”, by j. Beddoes M. J. Bibbi.
4. “Non conventional machining processes”, by P. K. Mishra, Narosa pub.
5. "Production technology" HMT hand book.
6. "Metals hand books"

2. ROBITICS & ROBOT APPLICATIONS

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Introduction: **- Robotics:**

Robot characteristics and classification, Manipulator and performance of robot, end-effetor, kinematics of robot, programming and robot languages VAL, VAL-PLUS, VAL II ARL. HARL, AL. PIAW, IRL. Robot application in manufacturing,

2. Developments in grippers and sensors:-

Introduction to tactile**,** proximity, optical sensors tactile array sensors, closed circuit control for **tactile** grippers and sensors , variable pressure and light converting sensors, visco elastic membrane type sensors, piezoelectric sensors high resolution pneumatic **tactile** sensors, roller type slip sensors special gripper design, analysis of force through FEM by visco elastic application.

3. Development in drives:-

Stepper motor drive - construction, working, step angle stepping rate torque dynamic detent torque, switching scheme/ wave and phase techniques & transient response, D C servo system motor: P I D control & the positional feedback/Hydraulic & pneumatic actuation - Rotary hydraulic drive - microprocessor based pneumatic control.

4. Robot application in manufacturing processes:-

Robotized welding: - MIG, spot welding, working principle/interfacing with controller or pc and uses of simulation packages,(GRASP- Gripping robot assembly simulation package)

Robotized inspection: - vision system with preprocessing segmentation pattern recognition, interpretation, image sensing, digitizing, image processing Neighborhood averaging, thresholding, smoothing of image Vision equipments CCD, raster scan, line scan, area sensing, automatic visual inspection.

Robotized other application: -

Distance-controlled robot medical, Bioengineering and genetic application

5. Robot path control:

Contour path and blending techniques, obstacle avoidance; LEE'S algorithm Cubic polynomial with via points.

Term work:-

Term work consists of assignment & case studies on above Syllabus

References:-

1. "Robotic technology & Flexible automation" by Dr S .R .DEB. Tata McGrew Hill
2. "Robotics & Image processing" Dr. P.A. Jankiram Tata McGrew Hill Publication
3. "Robotics application social implication" by Millers, S.M.Ballinger publishing
4. "Industrial Robotics vol I" Fundamentals vol II by Society Mfg.Engg.
5. "Handbook of Industrial robotics". Dearbon Michigam
6. "Robotics' engineering" Klafter. Chcmiclwski & Negin prentice hall. E.E.E Pub.
7. "Introduction to ROBOTIC'S" John J Craig Pearson education.

3. MANUFACTURING PROCESS MODELING

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1 .Introduction to Manufacturing Process Modeling:-

Types of Models, Principles of modeling. Automated Manufacturing System.

2. Queuing theory and simulation:-

Introduction to queuing models viz. M/M/l: FCFS/00/oo, and M/M/N; FCFS/M/C Introduction to simulation, need, models, application areas of simulation, discrete-event distributed , continuous, combined discrete-continuous and monte carlo simulation, modeling of queuing & inventory problems for simulation.

3. Graph theory: -

Introduction, Paths & circuit. Trees & fundamental Circuits, representation of graphs, graph theoretic algorithms, applications of graphs in mfg.

4. Regression methods:-

Introduction, models coefficient of co relation, least square methods, multiple regression, fuzzy variables, fuzzification & defuzzification & fuzzy regression, applications to mfg.

5. Neural network: -

Introduction, supervised & unsupervised learning, layered modeling of networks, application of neural network to classification & recognition problems.

6. **Search techniques: -**

Introduction to one dimensional & multidimensional search, genetic algorithm and simulated annealing.

Term work: -

It shall consists of minimum four assignments based on above syllabus

References: -

1." Graph Theory" By Narsing Deo, PHI.

2. " Simulation" By J. Banks. PHI.

3. " Performance modeling of automated, mfg. System" By Vishwanathan & Narhari, PHI

4."Simulation modeling and Analysis" A.M. LAWS and W.D.Keltron

4. MACHINE TOOL ENGINEERING

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work.- 25 Marks

1. Introduction: -

Metal cutting principles & design of machine tools, trends towards development of new metal cutting processes including dry machining & environmentally conscious machining

2. Evaluations:

Evaluation of force, Power consumption & tool life for turning , grinding, milling and drilling, optimum tool life based on total cost of machining, sensitivity analysis & significance by simplex search, graph theory & AHP techniques, fine machining & machining of hard alloys of steel & non Ferro Materials, high speed machining at elevated temp, or at sub zero condition.

3. Tool selection and Management.

Tool management in job/oriented FMS& tool/oriented FMS, Tool management system general.

4. Machine tool design:-

Drives: - Drives & control stepped & step less drive speed & structure diagram optimum ray diagram standardization by preferred number, compound ray diagram Friction drive variator, PIV. Epi-cyclic drive, torso, torodal ball variators, condition for self locking variators

Elements: design of slides on the basis of friction , hydrodynamic ,hydrostatic, aerostatic & hybrid lubrication/design of bed, tables & columns based on rigidity, natural frequency of vibration stress distribution & minimum deflection error/design of transmission system using sliding friction/lead screws/design based on static and dynamic load & amount of preload.

Control :- Design of spindle & spindle supports ,vibration of m/c tool, forced and self excited vibration stick-sleep vibration in machine tools & methods of minimizing slick slip error , micro displacement in machine tools, magneto-strictive drive , thermodynamic drive , control of electrical , thermal relay electric break, motor type relay , Ferromagnetic power clutch & basic circuit diagram for push button & other control system . Acceptance test in machine tools, static's & dynamic.

5. Tribological consideration in materials:

Tribological behavior of various materials and their uses in recent machine tool design.

Term work:-

It consists of at least four assignments based on above syllabus

References:-

1."Design of Machine Tools" by S.K.Basu and D.K.Pal Oxford & IBH

2. "Machine Tool Design" N.K. Mehta

3."Metal Cutting theory and cutting tool design" by V.Arshinov,G.AIekscev,Mir Pub

4."Principles of Metal Cutting Practices" A. Bhattacharya

5. ELECTIVES - II

5.1 TOTAL QUALITY CONTROL

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks

Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. **Introduction:**

   Core Concept of quality control, dimensions of quality, quality spiral, quality loop, customer satisfaction.

2. **TQM Philosophies: -**

   TQM Philosophy by Deming, Juran, Ishikawa, Crossby Imai, Conway, TQM case studies.

3. **Quality Costs :**

   Objective, cost of poor quality, quality cost classification. Estimating & analyzing Quality cost, hidden quality cost, economic models of quality cost, guidelines to establish & cut down quality cost.

4. **Tools for quality Improvement:**

   Seven New QC Tools, Advance control charting: CUSUM chart Moving, Average chart,Multi very Quality circles, six-sigma quality, ACC (Acceptance control chart).

5. **Quality Function Deployment (QFD) :**

   Concept, QFD Process, QFD Matrix , Deployment

6. **Taguchi's offline quality control :**

   Robust design, Quality loss function, parameter design, use of orthogonal arrays, performance measures S/ N ratio, ANOVA, Taguchi's recommended design technique: Multilevel column, dummy level, transfactor technique, Idle column, combining & confounding Technique.

7. **Quality standards :-**

   Quality assurance standards such as ISO 9000 series of Standards, Quality System standards, Various Clauses, Implementation, Documentation, Internal audits, Registration. Deming Prize criteria, Malcom Baldrige Award Criteria.

Term work :-

It consists of at least four assignments based on above syllabus

References: -

1. " Quality planning and analysis" by Juran
2. "TQM" by J. Bank.
3. ” Managing Total Quality" by N. Logollielis
4. "TQM" by Bestter field.
5. "Taguchi's Methods" by P. Ross.
6. "QFD" by R. G. Day.
7. "Quality Circles" by Sud & Ingle.
8. " ISO 9000 Std. Documents”

5.2 FINITE ELEMENT METHODS

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Introduction to FEM: -

Concept, background, applications, advantages & limitations of FEM recent advances, software in FEM.

2. FEM Procedure:

Stepwise procedure of finite element methods, convergence criteria, discreisation, selection of interpolation polynomials of shape functions, characteristic of shape function, Derivation of stiffness matrix & load vector Assembly of elemental equations, Application of boundary conditions.

3. **FEM Solution Technique :-**

Solution techniques for static, Eigen -valve &dynamic problems

4. **Variational Methods: -**

Calculation of variations, functional, variational methods, Rayleigh ritz method, equivalence of FEM & RR method, advantages of variational formulation.

5. Weighted residual methods:-

Concept, different types, Galerkin method, collocation method, application

6.1-D, 2-D, Element formulation: -

Bar triangular element, shape function, (B) matrix , derivation of element Stiffness & load vector, natural co-ordinates , applications ;

7. Iso -Parametric elements: -

Concept, principle, applications, element types, formulation of different elements, LaGrange's polynomial, convergence of isoparametric elements

8. Finite Element Analysis: -

Axi-symmetric and 3D problems

9. Application of FEM & heat transfer:

Formulation, of ID, & 2D problems

1 0 . Application of FF.M to manufacturing:-

Concept, modeling turning & drilling operations, boundary condition, formulation

Term work: -

It shall consists of assignments based on above syllabus

References;

1. "Finite element analysis , theory & programming ," C. S. Krishnamurthy,
2. " Finite element method" : O.C. Sienkiewicz
3. "The finite element method in Engg": S.S.Rao.
4. "Finite element method": J. K. Redely.
5. "Heat transfer" K.J. Bathe.
6. "FEM"byO.P. Gupta Oxford Pub

5.3 TRIBOLOGY

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

1. Tribology of Surface:

Surface irregularities measurement by Hcla, Hrms, **E** method, max. Height and auto correlation of surfaces. Apparent area of contact contacting areas, real area of contact, Abby's bearing area curve, load Vs contact ratio

2 Friction And Theories of Frictions:-

Adhesion, modified adhesion, single asperity abrasive theories etc. Amonton's and coulumb's law of friction, static & dynamic coefficient of friction & frictional behavior of solids under dry and lubricated condition.

3 Theories of wear and wear measurement :—

Pinion- disc method of measuring friction and wear

4. Lubrication: -

Theories of boundary & partial hydrodynamic, full hydrodynamic Summerfield equation, hydrostatics and aerostatics lubrication, hybrid -lubrication, hydrodynamic lubrication cum hydrostatic lubrication, aerostatic cum aerodynamic lubrication, design of general bearing with hydrodynamic & hydrostatic lubrication. Tilting pad journal bearing etc. tribological failure of machine members.

5. Use of Solid Lubrication in Machinary - MOS2, graphite etc,

6. Elasto Hydrodynamic lubrication:-

Squeeze failure lubrication. Gubins solution stepped slider bearing.

7. Ball and roller bearing Preload-

Bearing , Load rating under dynamic condition life & durability

Term work: -

It consists of four to five assignments on –

- Hydrodynamic journal bearing design
- Hydrostatics trust bearing
- Friction and wear measurement based on critical parameters
- Measurement of contact deformation
- Stepped slider bearing

References –

1."Tribology of bearings" By Mazumdar b. c. Wheeler book co.

2."Tribology" By Halling j.

5.4 COMPUTATIONAL TECHNIQUES

Teaching -3 Periods (60 min.each) per week. Uni. Exam Marks -100 Marks
Practical -2 Periods (60 min.each) per week. Term work. - 25 Marks

A. Numerical methods

1. **Approximation and Error**
2. **ROOTS OF EQUATIONS :-**
   Graphical interpretation bisection, false position N.R. method, secants application of above method
3. **SYSTEM OF LINEAR ALGEBRAIC EQUATION:-**
   Gauss elimination at fall of elimination, G. I. & G. S. methods error analysis & system condition
4. **CURVE FITTING :-**
   Least square regression linear, polynomial, multiple regression/interpolation & its application
5. **NUMERICAL DIFFERENTIAL & ITS INTEGRATION :-**
   Case study on cash flow analysis
6. **ORIDINARY DIFF EQUATION :**
   Eulees method, R. K. methods

CASE STUDY: -

Mathematical models for computer sales projection

B. Mathematical elements of ICG

1. **2-D Geometric transformations :-**
   Basic transformations; matrix representation and homogeneous Coordinates, concatenated transformation; general pivot point rotation and scaling, general reflection through arbitrary line
2. **3-D geometric transformation :-**
   Basic and general 3D transformation; orthographic projection, axonometric projections, auxiliary projections perspective projections
3. **Plane curves :-**
   Curve representation, parametric and non parametric representation; parametric representation of circle, ellipse, parabola, hyperbola, conics,
4. **Space curves :-**
   Introduction, representation of space curves, cubic splines, normalized cubic splines, parabolic blending, bezier curves, and B- splines curve
5. **Surface description and generation:-**
   Introduction. Surface of revolution, sweep surfaces, quadric surfaces, piecewise surface representation. Bilinear surface, ruled and developable surfaces, linear coons' surface, coons bicubic surface, bezier surface B spline surface

Term work: -

It consists of minimum four assignments based on above Syllabus

References:-

1. "Mathematical element for computer graphics", David f Rogers, J .Alan Admas.
2 "Procedural elements for computer graphics" David f. Rogers
3 " Computers graphics" Donald Hearn, M.Pauline Baker
4." CAD CAM Theory and practice" Ibrahim Zeid
5." Principles of computer graphics" Foley , van dam ; Addison Wesley
6." Computer graphics a programming approach" Harrington ; McGraw Hill pub
7." An introduction to solid modeling" maruti mantylla ; computer sciences press

6. SEMINAR

Teaching Scheme:
Tutorial/Practical: 2Hr./week/student Term Work: 25 Marks

The seminar shall consist of study of a particular topic based on 4 to 6 research papers on the case study of industries. The internal marks shall be awarded as the basis of performance of the individual student during his/her seminar presentation. Each student is also required to submit a report based on above study in the prescribed format.