BHARATI VIDYAPEETH UNIVERSITY,
Pune.

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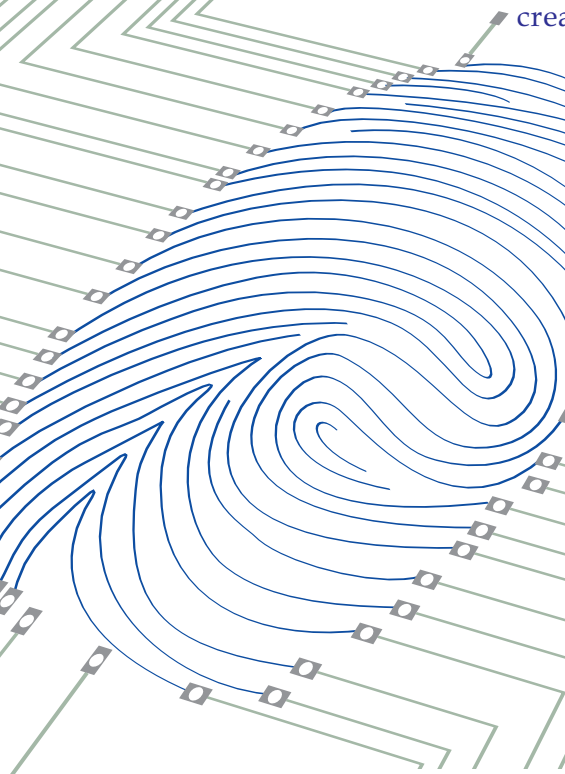

COURSE STRUCTURE & SYLLABUS

M. Tech. (Mechanical) (Semester - I to IV)

COURSE STRUCTURE & SYLLABUS

BHARATI VIDYAPEETH UNIVERSITY, PUNE

M. Tech. (MECHANICAL) (Sem. I to IV)

HIGHLIGHTS

Bharati Vidyapeeth University College of Engineering (BVUCOE) is the largest Engineering College in Maharashtra with an intake of 700 students in each academic year. Imparting quality technical education from Under Graduate to Doctorate Level, BVUCOE is probably the only Engineering College in India with an accreditation from both NAAC as well as NBA. The faculty at BVUCOE boasts of highly qualified academicians, a quality that is further emphasized by the fact that 15 of them are presently pursuing their Ph.D. degree.

BVUCOE has been ranked 29th amongst the Top 50 Technical Schools of India in survey conducted by DATAQUEST-IDC. We have enjoyed a ranking in this list for the last 4 years. Research is of utmost importance in all our programs. A total of 113 research papers were published in the academic year 2007-2008.

Currently we have 12 ongoing research projects. The infrastructure of BVUCOE is state-of-the-art with 62 classrooms, 59 laboratories and a well-stocked library that currently holds 27,130 titles. The college has an international presence with MoUs signed with the North Carolina A&T State University (Greensboro, USA), University of Venice (Italy), Actel Corporation (USA).Corporate interaction is also inculcated in our programs through our association with Oracle India Ltd., Infosys Ltd. and Tata Consultancy Services.

SALIENT FEATURES

The Mechanical Engineering Department has dedicated and enthusiastic staff and most of them are well qualified and experienced. The faculty is focused towards inculcating technical creativity in the students along with theoretical as well as practical knowledge. The excellent facilities are available to achieve this aim. The department has well equipped laboratories, and has modern equipment related to Mechanical Engineering.

In view to keep pace with the times, department has started the postgraduate course in CAD/CAM, which is unique in Pune region.

The Mechanical Engineering Student Association Organizes "RENAISSANCE" which is annual state level event. It is symposium comprising of paper presentation, Robotic competition, Quiz and Design competition.

MAJOR GROUPS/AREAS

Design Engineering , CAD/CAM (Computer Aided Design / Computer Aided Manufacturing, Heat Power Engineering, Manufacturing Engineering

EXPERTISE IN RESEARCH AND CONSULTANCY

Manufacturing, Electrochemical Machining, Design and FEM, Gear Dynamics, Tribology, Conical Air Bearing, Manufacturing, Solid Lubricants in Grinding, Mechanical Engineering department also conducts practicals for the students of engineering colleges in and around Pune.

MAJOR EQUIPMENTS

Steam Boiler, Steam Turbine, Advanced Pneumatic Trainer kit Hydraulics Trainer Kit, Hydraulic Power Pack, Emissivity Measurement Apparatus, Stephens, Boltzmann Apparatus, Clutch lining Testing Machine, Epicyclic gear trai, Governor, Gyroscope, Vibration Setup, Refrigerator Tutor, Multf Cylinder Petrol Engine, Diesel Engine Test Rigs

SOFTWARE

IDEAS Nx10, MATLAB, ANSYS, AUTOCAD, Windows NT

LABORATORIES

Steam Power Laboratory, Industrial Fluid Power Laboratory, Computer Graphics and Laboratory, Heat Transfer Laboratory, Theory of Machines Laboratory, Dynamics of

Machinery Laboratory, Elements of Mechanical Engineering Laboratory, Refrigeration and Air conditioning Laboratory, I.C. Engine Laboratory.

STRUCTURE & EXAMINATION PATTERN

M. Tech. - Mechanical Engineering

Semester I

Total Duration : 20 Hrs/Week
Total Marks : 500

Subject Code	Subject	Teaching Scheme (Hrs.)		Examination Scheme (Marks)				Total (Marks)
		L	P	Theory	Unit Test	Oral	TW	
K60501	Numerical Methods and Optimization	04	–	70	30	–	–	100
K60502	Computer Aided Design	04	02	70	30	25	25	150
K60503	Computer Integrated Manufacturing	04	-	70	30	–	–	100
K60504	Advance Finite Element Method	04	02	70	30	25	25	150
	Total	16	04	280	120	50	50	500

Teaching Scheme		Examination Scheme (Marks)				Total
Lectures	Practical	Theory	Test	Term Work	Oral	
16	04	280	120	50	50	500

Semester II

Total Duration : 20 Hrs/Week
Total Marks : 500

Subject Code	Subject	Teaching Scheme (Hrs.)		Examination Scheme (Marks)				Total (Marks)
		L	P	Theory	Unit Test	Oral	TW	
K60505	Reliability Engineering and Maintenance Management	04	02	70	30	25	25	150
K60506	Product Design and Development Strategies	04	-	70	30	-	-	100
K60507	Mechatronics in Manufacturing Systems	04	-	70	30	–	–	100
K60508	Advance Machine Design	04	02	70	30	25	25	150
	Total	16	04	280	120	50	50	500

Teaching Scheme		Examination Scheme				Total
Lectures	Practical	Theory	Test	Term Work	Oral	
16	04	280	120	50	50	500

STRUCTURE & EXAMINATION PATTERN

M. Tech. - Mechanical Engineering

Semester III

Subject Code	Subject	Teaching Scheme Hrs/Week		Examination Scheme (Marks)				Total (Marks)
		L	P	Theory	Unit Test	TW	Or	
K60601	Elective I	04	02	70	30	25	25	150
K60602	Elective II	04	02	70	30	25	25	150
K60603	Dissertation stage I	-	02	-	-	25	25	50
K60604	Seminar	-	01	0	-	-	25	25
	Total	08	07	140	60	75	100	375

Teaching Scheme Hrs/Week		Examination Scheme (Marks)				Total
Lectures	Practical	Theory	Unit Test	T. W.	Or.	
08	07	140	60	75	100	375

Semester IV

Subject Code	Subject	Teaching Scheme Hrs/Week		Examination Scheme (Marks)				Total (Marks)
		L	P	Theory	Unit Test	TW	Or	
K60605	Dissertation Stage II	-	04	-	-	150	75	225
	Total	-	04	-	-	150	75	225

Teaching Scheme Hrs/Week		Examination Scheme (Marks)				Total
Lectures	Practical	Theory	Unit Test	Oral	T. W.	
-	04	-	-	75	150	225

Elective – I

a. Manufacturing Information System
b. Advance Mechanism Design
c. Computational Fluid Dynamics
d. Advance Machine Tool Design

Elective II

a. Rapid Prototyping and Tooling
b. Machine Condition Monitoring and Diagnostics
c. Total Quality Management
d. Tribology in Design

Dissertation Stage I :

Students has to identify the project complete the literature survey and decide about the experimental set up if any.

Dissertation Stage II :

It is expected to complete the fabrication and experimentation and prepare a report.

RULES FOR CONDUCTING TESTS

Mode of the test

- Three unit tests per subject shall be conducted in each semester. The schedule for the same will be declared in the academic calendar of each term.
- Each unit test shall carry 30 marks.
- University examination pattern has given weightage of 30 marks for unit tests and 70 marks for theory examination
- To calculate final marks of the unit test following procedure is followed:

  i) Out of the three unit tests conducted during the semester, the marks of only two unit tests in which the candidate has shown his/her best performance shall be considered, to decide the provisional marks in each subject

  ii) Average marks obtained in two unit tests in which students have performed well shall be considered as provisional marks obtained by the student.

  iii) If the candidate appears only for two unit tests conducted during the semester, he/she will not be given the benefit of the best performance in the tests.

  iv) If the candidate appears only for one unit test conducted during the semester, to calculate the marks obtained in the unit tests it will be considered that the candidate has got 0(zero) marks in other unit tests.

  v) There is separate passing in theory examination. A candidate has to secure minimum 28 marks(i.e.40%) out of 70 marks to declare him/her pass. Provisional marks obtained by the candidate in unit tests should reflect as proportional to the marks obtained in theory examination. In case of disparity of more than 15% it will be scaled down accordingly. These marks will be final marks obtained by the student. No scaling up is permitted.

  vi) Unit test marks will be added in theory examination marks only after passing of candidate in theory examination in respective subject.
- Paper pattern for the unit tests:
- All questions are compulsory with weightage as following:

  Question 1 - 10 marks
  Question 2 - 10 marks
  Question 3 - 10 marks
- For granting the term it is mandatory to appear for all the three unit tests conducted in each semester.
- Roll numbers allotted to the students shall be the examination numbers for the unit tests.

SEMESTER - I

K60501: NUMERICAL METHODS AND OPTIMISATION

TEACHING SCHEME
Lectures : 04 Hrs/week

EXAMINATION SCHEME
Theory : 70 Marks
Duration : 03 Hours
Unit Test : 30 Marks

Unit-I (08 Hours)

Roots of Polynomial

Polynomial in engineering, Conventional method, Muller's Method, Bairstow's Method, Applications to Mechanical Engineering

Unit-II (08 Hours)

Linear Algebraic Equations

LU decomposition and Matrix inversion, LU decomposition matrix inverse error analysis and system condition, Applications to Mechanical Engineering.

Unit-III (08 Hours)

Partial Differential Equations

Elliptic equation, Laplace equation, Solution techniques, boundary condition control, volume approach. Parabolic Equation: Heat conduction equation, explicit Method, implicit method, Crank Nicolson Method.

Unit-IV (08 Hours)

One and Multidimensional Unconstrained and Constrained Optimization:

Golden section method, quadratic interpolation, Newton's method, Gradient methods.

Unit-V (08 Hours)

Constrained Optimization:

Linear Programming, Non-linear constrained optimization.

Unit-VI (08 Hours)

Dynamic Programming:

Simulation models & dynamic programming.

Text Books/ References

- M. K. Jain, S.R.K. Ayengar and R. K. Jain, "Numerical Methods for Scientific and Engineering Computations"
- V. Rajaraman, "Computer oriented Numerical methods", PHI, New Delhi
- S. S. Shastri, "Introductory Methods of Numerical Analysis", PHI, New Delhi
- Steven Chaptra and Raymond Canale, "Numerical Methods for Engineers", McGraw Hill
- N. Krishna Raju and K. U. Muthu, "Numerical Methods for Engineering", MacMillan India
- Hamdy A. Tata, "Operation Research and Introduction", McGraw Hill
- Richard Brownson, "Theory and Problems of Operation Research", Schaum's Outlined Series
- Hiller and Liberman, "Introduction to Operation Research", McGraw Hill

Syllabus for Unit

Unit Test 1	Unit I & IV
Unit Test 2	Unit II & V
Unit Test 3	Unit III & VI

K60502: COMPUTER AIDED DESIGN

TEACHING SCHEME	EXAMINATION SCHEME	
Lectures : 04 Hrs/week	Theory	: 70 Marks
Practicals : 02 Hrs/week	Duration	: 03 Hours
	Unit Test	: 30 Marks
	TW	: 25 Marks
	Oral	: 25 Marks

Unit-I (04 Hours)

Introduction:

Introduction to Computer Aided Design process, use of computers in design, graphic display devices, configuration of graphic workstation, fundamentals of 2D graphics.

Unit-II (08 Hours)

Transformations:

Introduction, Vector representation of geometric entities, output primitives (points, lines, curves etc) 2D, 3D transformations (Translation, scaling, rotation), windowing, view ports clipping transformation, Clipping, The Cohen-Sutherland Algorithm, Clipping of Polygons, three dimensional transformations.

Unit-III (10 Hours)

Curves:

Planer and space Curve – design analytical and synthetic approaches, cubic splines, bezier curves, B-splines NURBS and B-splines, patches, surface manipulation techniques, modeling of biparametric free form surfaces coons bezier, B-spline and NURB surfaces convention for node numbering, design range, current node pointer, Feature extraction and cut plan optimization techniques.

Unit-IV (10 Hours)

Geometric Solid Modeling:

Geometric modeling techniques, wire frame, solid modeling, Solid models, Fundamintals of solid Modeling, Sweep Representation, schemes for representing solid objects, pure primitive instancing, spatial

occupancys.enumeration, cell decomposition, constructive solid geometry (CSG), oundary representation (B-rep), hybrid, feature based, parametric and variational modeling.

Unit-V (08 Hours)

Data Structure:

Model storage and data structure, data structure for interactive modeling, simple data structure, display files, engineering data management system (EDMS), data structure organization, hierarchical data structure, network data structure, relational data structure, data storage and search methods, SQL, structure of database organization for modeling, accessing database from design programs.

Unit-VI (08 Hours)

Cad/cam Data Exchange Formats :

Graphic standards, Introduction, need, GKS, other graphic standards, PHIGS, structure networks, logical input devices, search and enquiry, structure archival and retrieval, structure travel and display, graphics output, name set mechanism, viewing pipeline, data exchange formats, DXF, IGES interfacing design and drafting, parametric design, script file, operations in batch mode.

Term work

Term work shall consist of the following:

- To develop algorithms, flow chart and programme for at least 6 mechanical engineering problems. Extensive use of software and programming languages is expected.
- Three assignments on the topics in the syllabus.

Oral/Practical

Based on Term work.

Text Books/References

- Rogers D. F., Adams A., "Mathematical Elements for Computer Graphics", MGH, 1989

- Faux I. D., Praftt M. J., "Computational Geometry for Design and Manufacture", John Wiley & Sons, 1979
- Mortenson M. E., "Geometric Modelling", John Wiley, 1989
- Dr. Sadhu Singh, "Computer Aided Design and Manufacturing", Khanna Pub. 1998
- Choi B. K., "Surface Modelling for CAD/CAM", Joh Wiley, 1991
- P.Radhakrishnan, C. P. Kothanadaraman, "Computer Graphics and Design", Dhanpat Rai Pub, 2002
- Hill Jr. F. S., "Computer Graphics"
- Baker Hearn, "Computer Graphics"

Syllabus for Unit Test

Unit Test 1	Unit I & IV
Unit Test 2	Unit II & V
Unit Test 3	Unit III & VI

K60503: COMPUTER INTEGRATED MANUFACTURING

TEACHING SCHEME
Lectures : 04 Hrs/week

EXAMINATION SCHEME
Theory : 70 Marks
Duration : 03 Hours
Unit Test : 30 Marks

Unit -I (08 Hours)

Computer Integrated Manufacturing:

Introduction, nature, evolution, development of CIM, fundamentals of CAD/CAM, computerized networks for manufacturing, future trends in CIM.

Unit –II (08 Hours)

Fundamentals of Manufacturing and Automation:

Production operations and automation strategies, production economics.

Unit-III (08 Hours)

Numerical Control Production Systems:

Numerical Control, computer numerical control, part programming, flexible manufacturing system.

Unit-IV (08 Hours)

Computer Aided Quality Control and Inspection:

Automated inspection and testing, QC and CIM, computer aided inspection using robots, integrated computer aided inspection system, flexible inspection system.

Unit-V (08 Hours)

Group Technology and Computer aided process planning, DNC and integration requirements, FMS design.

Unit-VI (08 Hours)

Control Systems

Introduction to control systems, linear control systems, linear feedback

control systems, optimal control, sequence control and programmable controllers, process control.

Text Books/References

- P. Radhakrishnan, S. Subramaniyam, "CAD/CAM/CIM"
- Mikelr P.Grover, "Automation Production Systems and Computer Integrated Manufacturing"
- Zimmers, Groover, "CAD/CAM"
- V. Ramamurthy, "Computer Aided Mechanical Design and Analysis"

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60504: ADVANCE FINITE ELEMENT METHOD

TEACHING SCHEME

Lectures : 04 Hrs/week
Practicals : 02 Hrs/week

EXAMINATION SCHEME

Theory	: 70 Marks
Duration	: 03 Hours
Unit Test	: 30 Marks
T.W.	: 25 Marks
Oral	: 25 Marks

Unit -I (08 Hours)

Historical Background – Basic concepts of FEM, Weighted residual method, Variational formulation, Approximation errors in FEM, Accuracy of solution, Boundary value problem and eigen value problem, Stress strain relations, linear and quadratic shape functions, Bar, Beam elements.

Unit –II (08 Hours)

One dimensional problems – Finite element modeling, Co-Ordinate and shape functions, Potential energy approach, Garlekin's method, Global stiffness matrix, properties of stiffness matrix, load vector, Penalty approach, Elimination approach, Multipoint constraints, Temperature effect, Basic boundary condition, Convergence of results.

Unit-III (08 Hours)

Finite Element Analysis of 2-D problems Basic boundary value problems in 2-D, Triangular, Quadrilateral, Higher order elements, Poisson's and Laplace equations, Constant strain triangle, stress calculation, temperature effect.

Unit-IV (08 Hours)

Isoparametric formulation – Natural Co-ordinate system, Lagrangian interpolation polynomials, Isoperimetric element, Formulation, Shape functions, Numerical integration, 1-D, 2-D triangular elements, rectangular elements.

Unit-V (08 Hours)

Solution to plane elasticity problems – Introduction to theory of elasticity, Plane stresses, Plane strain and Axisymmetric formulation, Principle of virtual work, Element matrices using energy approach.

Unit-VI (08 Hours)

Special Topics:- Dynamic Analysis, Equation of motion, mass matrices, Free vibration analysis, Natural frequencies of longitudinal , Transverse, Torsional vibration , Non linear analysis ,Use of software, p & h elements, special element formulator.

Termwork

- Term work shall consists of three assignment based on above syllabus.
- Four computer program assignments to be developed for FEA. Using programming language.
- Two assignment of structural and thermal using FEA Software

Oral/Practical

Term work and Oral will be based on above syllabus.

Text Books/References

- K. J. Bathe, "Finite Element Procedures", PHI
- R. D. Cook, D. S. Malus, M. E. Plesha, "Concepts and Applications of Finite Element Method Analysis", John Wiley
- J. N. Reddy, "An introduction to Finite Element Method Analysis", MGH
- Desai & Abel, "Introduction to Finite Element Methods"
- S. Riaseleharan, "FEA in Engineering Design"
- D. L. Logan, "A course in the Finite Element Method", Third Edition, Thomson Learning
- T. R. Chandrupatia, A. D. Belegundu, "Introduction to Finite Elements in Engineering", Third Edition, PHI

Syllabus for Unit Test

Unit Test 1	Unit I & IV
Unit Test 2	Unit II & V
Unit Test 3	Unit II & VI

SEMESTER - II

K60505: RELIABILITY ENGINEERING AND MAINTENANCE MANAGEMENT

TEACHING SCHEME		EXAMINATION SCHEME	
Lectures	: 04 Hrs/week	Theory	: 70 Marks
Practicals	: 02 Hrs/week	Duration	: 03 Hours
		Unit Test	: 30 Marks
		T.W.	: 25 Marks
		Oral	: 25 Marks

Unit -I (08 Hours)

Probability concepts, concepts of reliability, failure rate and hazard rate, common distribution in failure mechanism, system reliability analysis- parallel, series, standby, shared load and complex system; determination of system reliability- set theory, star-delta method, matrix method, and event tree method.

Unit –II (08 Hours)

Plant usage monitoring and evaluation of reliability through failure data analysis, concept loading roughness, probability in design including evaluation of safety margin.

Unit-III (08 Hours)

Optimum allocation of component reliability to achieve maximum system reliability, various techniques and methods, Monte Carlo simulation and Techno economic life.

Unit-IV (08 Hours)

Reliability, availability and maintainability of equipment, case studies in industrial applications.

Unit-V (08 Hours)

Fault Tree Analysis (FTA), Failure Mode and Effect Analysis (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA).

Unit-VI (08 Hours)

Replacement theories based on reliability effort function, in- built reliability in design and life castings.

Term work

Assignment on use of software (six).

Text Books/ References

- L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press
- K. C. Kapur and L. R. Lamlerson, "Reliability in Engineering Design", Wiley
- C. Singh, B. S. Dhillon, "Engineering Reliability – New Techniques and Applications", John Wiley & Sons
- Singh and R. Billinton, "System Reliability – Modeling and Evaluation", Hutchinson

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60506: PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

TEACHING SCHEME
Lectures : 04 Hrs/week

EXAMINATION SCHEME
Theory : 70 Marks
Duration : 03 Hours
Unit Test : 30 Marks

Unit -I (08 Hours)

Introduction :

Nature and scope of product engineering, creative thinking and organizing for product innovation, criteria for product success in life cycle of a product, effect of technological innovations on product development, technological forecasting, market identification, product life cycle management- a case study.

Unit –II (08 Hours)

Modeling and Simulation:

The role of models in product design, mathematical modeling, and similitude relations, weighted property index, optimization.

Unit-III (08 Hours)

Material Selection:

Problems of material selection, performance characteristic of materials, materials selection process, economics of materials, cost versus performance relations, weighted property index, value analysis- a case study.

Unit-IV (08 Hours)

Design Considerations:

Functional and production design, form design considering loading and material, form design of grey iron casting, malleable iron castings, aluminum castings, Pressure die castings, Plastic mouldings, welded fabrications, forging and manufacturing by machining methods, Influence of space, size, weight etc on form design, Aesthetic and ergonomic considerations.

Unit-V (08 Hours)

Tolerance and Analysis:

Dimensioning and Tolerencing the Product – functional, production and inspection datum-tolerance analysis.

Unit-VI (08 Hours)

Economic Decision Making:

Time value of money, cost comparisons, depreciation, taxes, profitability of investment, inflation, Break-even analysis, benefit-cost analysis, cost evaluation of product.

Text Books/ References

- Dieter, G. E., "Engineering Design", McGraw Hill, 1983
- Bralla, "Handbook of Product Design", McGraw Hill
- Niebel, B. W.& Draper, A.B.,"Modern Manufacturing Process Engineering", McGraw Hill, 1974
- Wade, Or, "Tolerance Control in Design and Manufacture", Industrial Press, Inc.
- Gladman C. A., "Manual for Geometric Analysis of Engineering Designs", Australian Trade Publications Ltd.
- Buhl H. R., "Creative Engineering Design", Iowa state University Press, 1960
- Jones J. C., "Design Methods", Inter Science, 1970
- Robert Matouseek, "Engineering Design", Blackie & Sons Ltd, 1963
- Harry Peck, "Designing for Manufacturing", Sir Issac Pitman and Sons Ltd, 1973

Syllabus for Unit Test

Unit Test 1	Unit I & IV
Unit Test 2	Unit II & V
Unit Test 3	Unit II & VI

K60507: MECHATRONICS IN MANUFACTURING SYSTEMS

TEACHING SCHEME

Lectures : 04 Hrs/week

EXAMINATION SCHEME

Theory : 70 Marks
Duration : 03 Hours
Unit Test : 30 Marks

Unit -I (08 Hours)

Introduction to Mechatronics:

Systems and components, Basic Electronic, Diode, Transistor, FET, Thyristros, Amplifiers, different types, Operational amplifier, characteristics, integrated circuits, VLSI, VVLIC.

Unit –II (08 Hours)

Sensors, transducers and Encoders, resolvers for position and motion control, solenoide valves, ball screws.

Unit-III (08 Hours)

Drives and Actuators, Digital and servomotors, hydraulic and Pneumatic motors, motor speed control, Electronic Hardware.

Unit-IV (08 Hours)

Electronic System Communication:

Interfacing and Buses, A/D and D/A Convertors, Integration of hard ware components, system response of Electronic and Mechanical systems.

Unit-V (08 Hours)

Software Control:

Applications of Microprocessor and Micro controller in Mechatronics.

Unit-VI (08 Hours)

PC Based Control:

Programming of user interface in high-level language, Graphic Simulation.

Text Books/ References

- Alciatore and Histand, "Introduction to measurement and mechatronic", Tata Mc Graw Hill Publication
- W.Boltol, "Mechatronic", Addi Wesley Longman Pub., II Edition
- Devas Sethy, Richard Colk, "Mechatronic System Design" PWS Publisher, ISBN –534-95285-2
- Kevin Croig and Fred Stolfi, "Introduction to Mechatronic System Design with Applications" Allied Publications
- Bush, "Mechatronics System Design-Theory and Application", Allied Publications
- Doblin, "Measurement System", McGraw Hill

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60508: ADVANCE MACHINE DESIGN

TEACHING SCHEME
Lectures : 04Hrs/week
Practical : 02Hrs/week

EXAMINATION SCHEME
Theory : 70 Marks
Duration : 03 Hours
Unit Test : 30 Marks
T. W. & Or. : 50 Marks

Unit -I (08 Hours)

Theory of Elasticity:

Basic Equation of elasticity, Two Dimensional problems in Cartesian coordinates, Two Dimensional problems in polar coordinates strain energy. The dummy load method, Rayleigh - Ritz method, Finite difference method.

Unit –II (08 Hours)

Creep:

Basic definitions, factors affecting strain accumulation, Methods of analysis for constant loading and temperature conditions, creep / fracture / enviro interactions, high temperature design procedures.

Unit-III (08 Hours)

Tribology:

Tribological consideration in design, Nature of solid surfaces, The shape of surfaces, Properties of surfaces, surface interaction with environment, Phase equilibria, Microstructures effects on friction and wear, Tribological applications of materials, Coatings and surface treatments. Bearing, seals, Gears, Cams and Tappets, Piston rings, Cutting tools, Forming tools etc.

Unit-IV (08 Hours)

Design for Manufacturability:

DFM Philosophy, design for quality, design for the life cycle, design for cost, use of CAE/CAD/CAM tools in DFM, Environmental design consideration, Implementation of DFM, Benefits of DFM.

Unit-V (08 Hours)

Statistical Considerations in Design:

Random variables, statistical sampling, Regression analysis, normal distribution, weibull distribution, goodness of fit, Chi-square test.

Unit-VI (08 Hours)

Computer applications in Design:

Computer Programming, Equation Solvers, Spreadsheets, Database and database processing.Design of shaft, Rolling contact, Sliding contact bearings, Spur/Helical worm gears using computer programming.

Termwork

Computer aided design analysis of any three-machine elements stated in unit-6.

Oral

Oral will be based on TW and syllabus.

Text Books/References

- Bharat Bhushan and B. K. Gupta,"Handbook of Tribology", Mc Graw Hill, 1991
- DFM, SME, "TMEH Handbook, Vol 6", Dearborn 4th Edition 1992
- R.K. Penny and D.L. Marriott, "Design for creep", Chapman and Hall, 2nd Edition 1995
- Sadhu Singh, "Theory of Elasticity", Khanna Publisher 4th edition 2000

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

SEMESTER - III

K60601 ELECTIVE I: MANUFACTURING INFORMATION SYSTEM

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory	: 70 Marks
Duration	: 03 Hours
Unit Test	: 30 Marks
Termwork	: 25 Marks
Oral	: 25 Marks

Unit-I (08 Hours)

Knowledge based system, Introduction, Development of data base and knowledge bases, knowledge representing paradigms – rule based, object oriented, semantic nets and frames, uncertainty, fuzzy logic, neural nets.

Unit-II (08 Hours)

Interference mechanism, goals, control strategies forward and backward chaining, conflict resolution, explanation, blackboard model.

Unit-III (08 Hours)

Implementation issues: knowledge acquisition, coding, expert system shells, PROLOG, and LISP.

Unit-IV (08 Hours)

Selected applications in manufacturing: product design, process planning and scheduling, robot movement, factory layout, defect analysis, diagnostic maintenance, quality control.

Unit-V (08 Hours)

Knowledge based approaches for engineering design, blackboard architecture, other knowledge based approaches.

Unit-VI (08 Hours)

Artificial intelligence.

List of Practical

Based on above termwork.

Oral

Based on above termwork.

Term Work

Three case studies from the following

- Information and knowledge requirement in Manufacturing Function
- Inventory control systems
- Production Planning and Control System – Scheduling and capacity requirement calculation.
- Design information systems.

Text Books/ References

- Kerr R., "Knowledge Based Manufacturing Management", Addision Wiley, 1991
- Addis T. R., "Designing Knowledge Based System", Prentice Hall, 1985
- Roltson D. W., "Principles of Artificial Intelligence and Expert Systems Development", McGraw Hill Publications, 1988
- Chung P. W. H., Love Grove G., "Industrial Engineering Applications of AI and Expert Systems", Gordon & Breach Science Pub., 1993
- Maus R. and Keyes J., "Hand Book of Expert Systems in Manufacturing", McGraw Hill Publications, 1991
- C. S. Krishnamurthy, S. Rajeev, "Computer Aided Design" Narosa Pub. House

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60601 ELECTIVE I:
ADVANCED MECHANISMS DESIGN

TEACHING SCHEME

Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory	: 70 Marks
Duration	: 03 Hours
Unit Test	: 30 Marks
Termwork	: 25 Marks
Oral	: 25 Marks

Unit-I (06 Hours)

Introduction:

Review of fundamentals of kinematics, D. O. F; Multi loop kinematics chains, Gross motion concepts; Position analysis -Vector loop equations for four bar slider crank.

Unit-II (08 Hours)

Kinematic Analysis:

Inverted slider crank - Geared five bar and six bar linkages; Analytical method for velocity and acceleration analysis - Four bar linkage jerk analysis - Plane complex mechanism.

Unit-III (09 Hours)

Path Curvature Theory:

Fixed and Moving centroids, inflection points and inflection circle; Graphical constructions - Cubic of stationary curvature; Dimensional synthesis – Function generation; path generation, motion generation.

Unit-IV (08 Hours)

Synthesis of Mechanisms

Graphical methods; Coupler; curve synthesis, design of six bar mechanisms. Algebraic methods. Application of instant centre in linkage design; Cam mechanism - Determination of optimum size of Cams.

Unit-V (08 Hours)

Dynamic of Mechanisms

Static force analysis with friction - Inertia force analysis - combined static

and inertia force analysis; shaking force, Kinetostatic analysis. Introduction to force and moment; balancing of linkages. The Matrix Method.

Unit-VI (08 Hours)

Spatial Mechanism and Robotics:

Kinematic analysis of spatial RSSR mechanism; Denavit - Hartenberg parameters; Forward and inverse Kinematics of robotic manipulators.

List of Practical

Based on Term work.

Oral :

Based on Term work.

Term work:

Practical in Use Of Mechanical Software Packages- Tutorials.

Text Books/ References

- Erdman A G & Sandor, G N, "Mechanism Design: Analysis and Synthesis", prentice hall of India
- Mallik, A K, Ghosh A, and Gunter Dittrich, "Kinematic Analysis and Synthesis of Mechanisms", CRC Press London
- Robert L Norton, "Design of Machinery" McGraw Hill Book Co.
- Robert HA, "Mechanical Design Systems Handbook", McGraw Hill Book Co.

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60601 ELECTIVE I: COMPUTATIONAL FLUID DYNAMICS

TEACHING SCHEME

Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory	: 70 Marks
Duration	: 03 Hours
Unit Test	: 30 Marks
Termwork	: 25 Marks
Oral	: 25 Marks

Unit -I (08 Hours)

Introduction to Fluid Dynamics, Concepts of Fluid Flow, Pressure distribution in fluids, Reynolds transport theorem, Integral form of conservation equations, Differential form of conservation equations, Different Types of Flows, Euler and Navier Stokes equations, Properties of supersonic and subsonic flows, Flow characteristics over various bodies.

Unit –II (08 Hours)

Geometric Modeling and CAD Repairing Geometric transformations, Parametric representation of curves and surfaces, Concept of topology, Surface modeling, Faceted models, Solid modeling. Creation of water tight geometry, Faceted Boolean operations, Dependent and independent CAD errors.

Unit-III (08 Hours)

Introduction to CFD, Philosophy of CFD, Governing equations of fluid dynamics and there physical meaning, Mathematical behavior of governing equations and the impact on CFD simulations, Simple CFD techniques and CFL condition.

Unit-IV (08 Hours)

Numerical Methods in CFD, Finite Difference, Finite Volume, and Finite Element, Upwind and downwind schemes, Simple and Simpler schemes, Higher order methods, Implicit and explicit methods, Study and transient solutions.

Unit-V (08 Hours)

Surface mesh generation, Surface mesh repair, Volume grid generation, Volume mesh improvement, mesh smoothing algorithms, grid clustering and quality checks for volume mesh. Adaptive, Moving and Hybrid Grids, Need for adaptive and, moving grids, Tet, pyramid, prism, and hex grids, using various elements in combination.

Unit-VI (08 Hours)

Introduction to Turbulence Modeling, Introduction and background, Algebraic models, One equation models, Two equation models, Near wall treatment, Reynolds stress models, Introduction to Multiphase Modeling Fundamentals of multiphase flows, Eulerian - Lagrangian (ELAG) approach, Eulerian- Eulerian (E2P) approach, Volume Of Fraction (VOF) approach.

List of Practical

Based on Term work.

Oral :

Based on Term work.

Termwork

Minimum four assignments on above topic to study CFD analysis.
Use of Any CFD software like FLUENT – Basic issues, model development, and post process sing.

Text Books/ References

- John D. Anderson, "Computational Fluid Dynamics: The Basics with Applications", McGraw Hill, 1995
- V. V. Ranade, "Computational Flow Moeling for Chemical Reactor Engineering", Process Engineering Science, Volume 5, 2001
- Patrick Knupp and Stanly Steinberg, "Fundamentals of Grid Generation", CRC Press, 1994
- D. C. Wilcox, "Turbulence Modelling for CFD", 1993

- Pieter Wesseling, "An Introduction to Multigrid Methods", John Wiley & Sons, 1992
- J. F.Thompson, Z. U., A. Warsi and C. W. Mastin, "Numerical Grid Generation: Foundations and Applications", North Holland, 1985
- S. V. Patankar, "Numerical Heat Transfer and Fluid Flow", McGraw-Hill,1981
- Thomas B. Gatski, M. Yousuff Hussaini, John L. Lumley,, "Simulation and Modelling of Turbulent Flows", Eds., Oxford University Press, 1996
- Laney, C. B., "Computational Gas Dynamics", Cambridge Uni. Press, 1998

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60601 ELECTIVE I:
ADVANCE MACHINE TOOL DESIGN

TEACHING SCHEME

Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory	: 70 Marks
Duration	: 03 Hours
Unit Test	: 30 Marks
Termwork	: 25 Marks
Oral	: 25 Marks

Unit -I (08 Hours)

Introduction:

Introduction to Metal Cutting Machine tools, Kinematics, Basic Principles of Machine tool design, estimation of drive power.

Unit –II (08 Hours)

Design of Machine Tool Spindle and Bearings:

Design of power screws - static deformation of various machine tool structures - thin walled box structures with open and compliant cross sections - correction coefficients - design of beds, columns, tables and supports.

Unit-III (08 Hours)

Dynamics of Cutting Forces :

Tool chatter - design of sideways. Concepts of aesthetics and ergonomics applied to machine tools. Latest trends in Machine Tool Design, Introduction to CAD techniques.

Unit-IV (08 Hours)

Design Considerations:

Electrical, Mechanical and Hydraulic drives in machine tool, stepped and step less arrangements and systems.

Unit-V (08 Hours)

Design of Control Mechanisms:

Selection of standard components - Dynamic measurement of forces.

Unit-VI (08 Hours)

Vibrations in Machine Tools :

Stability against chatter - use of vibration dampers. Acceptance tests and standardization of machine tools - machine tools reconditioning.

List of Practical

Based on Term work.

Oral :

Based on Term work.

Text Books/ References

- Mehta, N. K., "Machine Tool design", Tata McGraw Hill, 1989
- Koenisberger F., "Design Principles of Metal cutting Machine Tools", Pergamon Press, 1964
- Acherkan N., "Machine Tool Design", Vol. 3&4, MIR Publishers, Moscow, 1968
- Sen. G. and Bhattacharya A., "Principles of Machine Tools", Vol.2, NCB. Calcutta, 1973

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60602 ELECTIVE II:
RAPID PROTOTYPING & TOOLING

TEACHING SCHEME		EXAMINATION SCHEME	
Lectures	: 04 Hrs/week	Theory	: 70 Marks
Practical	: 02 Hrs/week	Duration	: 03 Hours
		Unit Test	: 30 Marks
		Termwork	: 25 Marks
		Oral	: 25 Marks

Unit-I (08 Hours)

Introduction:

Development of Rapid Prototyping and its Applications; Benefits over other processes of model making.

Unit –II (08 Hours)

Materials:

Desirable properties for Rapid Model Making; Materials used in RP; Polymer properties.

Unit-III (08 Hours)

Rapid Prototyping Processes -I:

Stereo Lithography; Lasers and their use in Solid making; Laser exposer and Material Deposition; Curing and other post processes.

Unit-IV (08 Hours)

Rapid Prototyping processes -II:

Non laser Processes- Cubital, Helisys and other processes; Solid Ground Curing; Light Sculpturing; liquid deposition; 3-D printing and other newly developed processes and related processes; Part finishing.

Unit-V (08 Hours)

Computer Application, Scope, Limitations and Trends:

Software Architecture; Developing Computer based STP files for feeding model data for Rapid Prototyping Limitations and future trends.

Unit-VI (08 Hours)

Examples and Case Studies

List of Practical

Based on Term work.

Oral :

Based on Term work.

Term work

Exercises in development of Software and process simulation.

Text Books/ References

- Paul F. Jacobs and David T. Reid, "Rapid Prototyping and Manufacturing - Fundamentals of Sterolithography", SME and McGraw Hill publications
- Smith PG, and Reinertsen, DG, "Developing Products in half time", Van Nostrand Reinhold, New York 1991
- Siegman, A E., "An introduction to Lasers and Masers", McGraw Hill, New York, 1971
- Cooper Kenneth C., "Rapid Prototyping Technology Selection and Application", Marcel DekkarInc., New York, 2001

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60602 ELECTIVE II: MACHINE CONDITION MONITORING AND DIAGNOSTICS

TEACHING SCHEME

Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME

Theory	: 70 Marks
Duration	: 03 Hours
Unit Test	: 30 Marks
Termwork	: 25 Marks
Oral	: 25 Marks

Unit -I (08 Hours)

Predictive Maintenance Techniques:

Predictive maintenance basics, Maintenance philosophies, Evolution of maintenance philosophies, Plant machinery classification and recommendations, Principles of predictive maintenance, Predictive maintenance techniques, Vibration analysis – a key predictive maintenance technique.

Unit –II (08 Hours)

Fundamentals of Vibrations:

Vibration basics, Spring-mass system: mass, stiffness, damping, System response, What is vibration? The nature of vibration, Harmonics, Limits and standards of vibration.

Unit-III (08 Hours)

Data Acquisition:

Introduction, Collection of vibration signal – vibration transducers, characteristics and mountings, Conversion of vibrations to electrical signal.

Unit-IV (08 Hours)

Signal Processing, Applications and Representation:

The fast Fourier transform (FFT) analysis, Time waveform analysis, Phase signal analysis, Spectral signal processes.

Unit-V (08 Hours)

Machinery Fault Diagnosis Using Vibration Analysis:

Commonly witnessed machinery faults diagnosed by vibration analysis,

correcting faults that cause vibration; Balancing, Alignment, Resonance vibration control with dynamic absorbers.

Unit-VI (08 Hours)

Oil and Particle Analysis Oil Fundamentals:

Condition-based maintenance and oil analysis, Setting up an oil analysis program, Oil analysis – sampling methods, Oil analysis – lubricant properties, Oil analysis – contaminants in lubricants, Particle analysis techniques, Alarm limits for various machines.

List of Practical

Based on Term work.

Oral :

Based on Term work.

Termwork

Term work shall consists of

- Data acquisition using a velocity pickup.

  Data acquisition using an accelerometer.

  Data acquisition of sound signals.

  Spectral analysis of velocity, acceleration noise signals.

  Experiment demonstrating balancing of rotating shaft shaft.
- Three assignments based on above syllabus.

Text Books/ References

- Thomson, W. T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990
- Gupta K., "Introductory Course on Theory and Practice of Mechanical Vibrations", New Age International Ltd., 1984

- J. S. Rao., "Vibratory Condition Monitoring of Machines", Narosa publishing house, New Delhi
- Cyril M. Harris, Allan G. Piersol, "Shock and Vibration Handbook", McGraw-Hill Publishing Co.
- C. Scheffer, Paresh Girdhar, "Practical Machinery Vibration Analysis and Predictive Maintenance", Newnes an imprint of Elsevier

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60602 ELECTIVE II: TOTAL QUALITY MANAGEMENT

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 70 Marks
Duration : 03 Hours
Unit Test : 30 Marks
Termwork : 25 Marks
Oral : 25 Marks

Unit -I (08 Hours)

The new philosophy of quality, product quality and its prospects, quality planning and control.

Unit –II (08 Hours)

Economics of quality control, tolerances and process capability studies, quality cost audit.

Unit-III (08 Hours)

Total quality management, quality assurance, quality conformance, principles of total quality management.

Unit-IV (08 Hours)

ISO-9000, 2000 standard and certification.

Unit-V (08 Hours)

Concepts of quality circles, use of decision trees, O-R-models and simulation in process control.

Unit-VI (08 Hours)

Process control and sampling inspection, process capabilities studies, product quality and reliability.

List of Practical

Based on Term work.

Oral

Based on Term work.

Text Books/References

- J. S. Matrinich, "Production and operation Management", John Wiley & sons
- Grant E. L. and R. Leavenworth, "SQC", McGraw Hill
- Deming W. Ewards, "Quality Productivity and Competitive Position", MIT Centre for Engineering studies, Cambridge Inc. 1982
- Dale H. Basterfield, Carol Basterfield Mincha, Glen H. Basterfield, Mary Basterfield Sacre, "Top Quality Management Management", Pearson Education Asia, Low Price Second Edition, 2001

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60602 ELECTIVE II: TRIBOLOGY IN DESIGN

TEACHING SCHEME		EXAMINATION SCHEME	
Lectures	: 04 Hrs/week	Theory	: 70 Marks
Practical	: 02 Hrs/week	Duration	: 03 Hours
		Unit Test	: 30 Marks
		Termwork	: 25 Marks
		Oral	: 25 Marks

Unit -I (08 Hours)

Introduction to Tribology:

Introduction, Friction, Wear, Wear Characterization, Regimes of lubrication, Classification of contacts, lubrication theories. Newton's Law of viscous forces, Effect of pressure and temperature on viscosity.

Unit –II (08 Hours)

Hydrodynamic Lubrication:

Newton's Law of viscous forces, Flow through stationary parallel plates. Hagen's poiseuille's theory, viscometers. Concept of lightly loaded bearings, Petroff's equation, Hydrodynamic Bearings, Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynolds's 2D equation with assumptions. Introduction to idealized slide bearing with fixed shoe and Pivoted shoes. Expression for load carrying capacity. Location of center of pressure.

Unit-III (08 Hours)

Hydrostatic Bearings:

Types of hydrostatic Lubrication systems Expression for discharge, load carrying capacity, Flow rate, Condition for minimum power loss. Torque calculations.

Unit-IV (08 Hours)

Elasto Hydrodynamic Lubrication:

Introduction to Elasto - hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution, Different regimes in EHL contact.

Unit-V (08 Hours)

Porous, Gas Bearings and Magnetic Bearings:

Introduction to porous bearings. Equations for porous bearings and working principal, Fretting phenomenon and it's stages.

Introduction to gas bearing, Governing Equation, Infinitely long journal bearings, Externally pressurized gas bearing. Introduction to magnetic bearings, Active magnetic bearings. Different equations used in magnetic bearings and working principal. Advantages and disadvantages of magnetic bearings, Electrical analogy, Magneto-hydrodynamic bearings.

Unit-VI (08 Hours)

Tribo Measurement In Instrumentation:

Surface topography measurements - Electron microscope and friction and wear measurements - Laser method - Instrumentation - International standards - Bearings performance measurements - Bearing vibration measurement.

Lis of Practical

Practicals to be conducted on

- Journal Bearing Apparatus
- Tilting Pad Thrust Bearing Apparatus
- Study of Lubrication System
- Friction in Journal Bearing
- Brake lining friction Test Rig
- Air Bearing Apparatus

Oral

Term work and oral will be based on above syllabus

Text Books/References

- Cameron, A. "Basic Lubricaton Theory", Ellis Herward Ltd. , UK,1981

- Hulling , J. (Editor), "Principles of Tribology", MacMillan ,1984
- Williams J. A ., "Engineering Tribology", Oxford Univ. Press ,1994
- Neale M. J., "Tribology Hand Book ", Butterworth Heinemann, 1995
- Basu S. K., Sengupta S. N., Ahuja B. B., “Fundamentals of Tribology” Prentice Hall of India Privata Ltd. New Delhi, 2005
- Mujamdar B. C ., "Introduction to Tribology of Bearing", Wheeler Publishing, New Delhi 2001
- Susheel Kumar Srivasthava, "Tribology in industry", S. Chand and Co.
- Dudley D. Fuller, " Theory and practice of Lubrication for Engineers", New York Company 1998
- Moore, "Principles and applications of Tribology", Pergamon press
- Pinkus Stemitch, "Theory of Hydrodynamic Lubrication"
- Gerhand Schwetizer, Hannes Bleuler & Alfons Traxler, "Active Magnetic bearings", Authors working group
- Radixmovsky, "Lubrication of Bearings - Theoretical Principles and Design" The Oxford press Company, 2000

Syllabus for Unit Test

Unit Test 1	Unit I & II
Unit Test 2	Unit III & IV
Unit Test 3	Unit V & VI

K60603 DISSERTATION STAGE I

TEACHING SCHEME
Practical : 02 Hrs/week

EXAMINATION SCHEME
Termwork : 25 Marks
Oral : 25 Marks

Stage-I:

The aim of the dissertation work is to carry out research and development work. Every student will be required to choose the topic of dissertation in consultation with the faculty guide.

This stage will include a report consisting of synopsis, the plan for experimental/theoretical work and the summary of the literature survey carried out till this stage.

K60604 SEMINAR

TEACHING SCHEME
Practical : 01 Hrs/week

EXAMINATION SCHEME
Oral : 25 Marks

The student will be required to choose the topic of seminar on advanced topics based on courses taught in first and second semester and present the work during the seminar.

SEMESTER - IV

K60603 DISSERTATION STAGE II

TEACHING SCHEME
Practical : 04 Hrs/week

EXAMINATION SCHEME
Termwork : 150 Marks
Oral : 75 Marks

Stage-II:

This stage will include comprehensive report on literature survey, design and fabrication of experimental set up and / or development of model, relevant computer program. The student is require to publish at least one national/international paper based on the dissertation work. The publication / accepted paper for publication shall be included in the report.

Student has to submit the authentic copy of dissertation Stage-I report.

RULES REGARDING ATKT, CONTINUOUS ASSESSMENT AND AWARD OF CLASS

A. T. K. T.

- A candidate who is granted term for M.Tech Semester-I will be allowed to keep term for his/her M.Tech. Semester-II examination even if he/she appears and fails or does not appear at M.Tech. Semester-I examination.
- A candidate who is granted term for M.Tech Semester-III will be allowed to keep term for his/her M.Tech. Semester-IV examination even if he/she appears and fails or does not appear at M.Tech. Semester-III examination.
- A student shall be allowed to keep term for M.Tech Semester-III even if he/she has a backlog of all Heads of passing in theory examination held at M.Tech Semester I & II taken together.
- A student has to secure 40% marks in theory and 50% marks in TW & oral as a condition of pass class. The overall percentage of marks of all semesters taken together should be more than 50% to declare the student to be passed.

CONTINUOUS ASSESSMENT

- The term work assessment will be based on the practical/assignment as described in the syllabus.
- Final assessment of termwork shall be done by pair of internal and external examiners jointly during the oral/practical examination schedule declared by the university. The teacher conducting practicals/assignments during the term shall maintain a record of continuous assessment. Every practical/term work/assignment shall be assessed continuously on the scale of 20 marks and weightage of 20 marks shall be distributed as follows:

Sr. No.	Activity	Marks
1	Timely Submission	04
2	Presentation	06
3	Understanding	10

This record of continuous assessment shall be made available to the examiners during Term work and oral examination. Examiner shall use this record for overall assessment of the performance of the student.

- Assessment of the seminar work and dissertation work shall be done continuously.

• Record of this assessment shall be made available during examination. The student should submit the dissertation stage-I report along with the dissertation stage-II report at the time of final submission.

CLASS

• The class should be awarded to the student on the basis of aggregate marks obtained together in both the semesters of the respective year by him/her. The award of class shall be as follows.

A	Aggregate 66% or more marks	First Class with Distinction
B	Aggregate 60% or more marks but less than 66%	First Class
C	Aggregate 55% or more marks but less than 60%	Higher Second Class
D	Aggregate 50% or more marks but less than 55%	Second Class
E	Aggregate 40% or more marks but less than 50%	Pass Class