SOLAPUR UNIVERSITY, SOLAPUR

Course Work for Ph.D. – Mechanical Engineering

(w.e.f. June-2014-15)

Paper No.	Name of the Subject	Type	Examination Scheme			Duration of Paper
			T/W	Theory	Oral	
I	Research Methodology & Information Communication Technology	Compulsory	--	100	--	3 hrs
II	Modern Topics in Mechanical Engineering from Performance Improvement Perspective	Compulsory	-	100	--	3 hrs
III	Elective -I	*	--	100	--	3 hrs

***Any one subject as Elective is to be studied and examined**
As recommended by Guide

Sr. No.	Elective Subject
1	Advanced Developments in Industrial & Production Engineering
2	Advanced Developments in Mechanical Design Engineering
3	Advanced Developments in Thermal Engineering

Ph.D. Mechanical Engineering Paper-II

Modern Topics in Mechanical Engineering from Performance Improvement Perspective

Teaching Scheme
Lecturers: 3 Hrs/ Week

Examination Scheme
Theory: 100 Marks

Name of the topic	Contents	Hours	Remarks
1. Creating quality by design	Product development cycle, Assessment of customer's needs, Formulation of design specifications, Preliminary design, General consideration for a good design, functional efficiency, safety, reliability, maintainability, ease of production, standardization, review of design, evaluation of prototype, preparation of manufacturing drawings, formulation of product specifications, design changes during production, Economics of quality.	8	
2. Quantity Function Deployment (QFD)	Introduction , Kano model of QUALITY , History of QFD, Components of QFD model Steps of QFD. Advantages , limitations of QFD , Successful cases of QFD QFD and other tools , QFD in Service industries	6	
3. Design Optimization	Need , Application , classification , Formulation Statement formulation , stakeholders of process Design parameters , Robust Design , Portfolio design Optimization programming , optimization design of mechanical system	6	
4. Quality Control of manufacturing process	Quality planning for manufacturing, process capability, process control & its techniques, Statistical Process control techniques, Manufacturing Quality Control, Control of Product during inspection & disposal of rejected products.	10	

5. ISO 9000	ISO 9000 series of standards , Need , Principles of QMS , process approach , Requirements of ISO 9001 : 2008 , Implementation , Evaluation of QMS , Continual improvement in ISO 9001	**6**	
6. Six Sigma	Changing business scenario , History of Six Sigma , Success stories ,Management , Improvement strategies , Difference between TQM and Six Sigma Key process input variables , Key process Output variables , concept of variation , Sigma conversion table , standard deviation DMAIC model of Six Sigma , Six Sigma roadmap , Six Sigma Infrastructure (Champion, black belt etc.) Measuring current performance , Data collection , Sampling plans , baseline defects ,measures , identification of improvement opportunities , Calculation of defects per million opportunity (DPMO) Six Sigma analysis and improvement , Six Sigma tools , Root cause analysis , cause and effect diagram , Pareto chart , time series plot , run chart Failure mode and effect analysis (FMEA) Do's and Don'ts of Six Sigma , Project selection Introduction to Design Of Experiments (DOE)	**14**	
Total Hours		**50**	

References:

1. Quality Handbook– Juran J.M. McGraw hill Publication.
2. Grant S.P. - Statistical Quality Control- Tata McGraw hill Publication.
3. Organizational excellence through Total Quality Management- H. Lal, New Age Intl. Publishers, New Delhi.
4. Francis T. Farago, Mark A. Curtis- Handbook of dimensional measurement.
5. Harrison M., Wordsworth, Stefeen Godfrey-- Modern Methods for Quality Control and Improvement, Wiely Publication.
6. Quality Control Kulkarni— V. A. and Bewoor A. K.John Wiley Publication, New Delhi.

Ph.D. Mechanical Engineering Paper-III

Advanced Developments in Industrial & Production Engineering (Elective-I)

Teaching Scheme	Examination Scheme
Lecturers: 3 Hrs/ Week	Theory: 100 Marks

Operations Strategy - Competitive priorities, strategic decisions in operations, strategy deployment (2)

Forecasting - Casual and Time series models, Simple and weighted moving average, Exponential smoothing, Trend and Seasonality. (4)

Layout - Designing process layouts, product layouts, service layouts, Line balancing. (6)

Aggregate Planning and Capacity Planning - Process of aggregation, Pure and mixed strategies, Chase demand and levelling strategies, Techniques for aggregate planning**,** Defining and measuring capacity, Tools for capacity planning. (6)

Inventory Management and Resource Planning - Inventory Costs, Functions, Inventory control systems, How much to order – EOQ, EPQ, Quantity discounts, Overview of Material Requirement Planning (MRP), Master production schedule (MPS), Inputs to MRP, The MRP process, Lot sizing in MRP systems, MRP outputs, Introduction to Enterprise Resource Planning (ERP). (6)

Supply Chain Management - Management of supply chains, Distribution, Information Technology – a supply chain enabler, measuring supply chain performances. (4)

Lean Production - Just in Time (JIT) and lean production, The basic elements of lean production – Flexible resources, Cellular layouts, Pull system, KANBANs, Small lots, Quick setups, Uniform production levels, Quality at Source (6)

Scheduling - Loading – Load profile, Gantt chart, Assignment method; Sequencing – Priority sequencing rules, Johnson's rule, other criteria; Scheduling – Gantt chart scheduling, Forward and backward scheduling, Theory of constraints. (6)

References :

Operations Management – Krajewski and Ritzman
Operations Management – Russell and Taylor
Production planning and Inventory Control – Narsimnhan, Maleavey, and Billington.
Operations Management – Stevenson
Production and operation management – Adam and Ebert
Production and operation management – Martinich

Ph.D. Mechanical Engineering Paper-III

Advanced Developments in Thermal Engineering (Elective-II)

Teaching Scheme	Examination Scheme
Lecturers: 3 Hrs/ Week	Theory: 100 Marks

Unit 1:Thermodynamics: Laws of thermodynamics, Entropy, Irreversibility and Availability, Behaviour of ideal and real gases, Calculation of work and heat in ideal processes. Analysis of thermodynamics cycles related to energy conversion.

Unit 2: Heat Transfer: Modes of heat transfer, Resistance concept, Unsteady heat conduction, Fins,Effect of turbulence, Radiative heat transfer, black and grey sufaces shape factors, network analysis, Heat exchangers.

Unit 3: Mass Transfer:

Mass transfer - 1, Droplet vaporization -1, Mass transfer-2, Droplet vaporization – 2, Mass transfer- 3 (Any two)

Unit 4: Combustion:

Premixed and Diffusion flames

Unit 5: Computational Fluid Dynamics –

Finite volume algorithm, up-winding, Solution of pressure field on Cartesian meshes Mesh generation technique

Unit 6: Turbulence

Governing equations, Free shear flows, Near wall behavior, Energy spectrum, Turbulence Models Solution on Non-Cartesian meshes.

Unit 7: Advanced Topics in Refrigeration and Cryogenics

Refrigeration applications in preservation of Food, transport by trucks and containers; Railway cars; Marine
Refrigeration; Fans and Blowers, Sound Control. Construction of psychrometric charts, enthalpy deviation curves (Any two)

Unit 8:Energy Conversion System: Basic cycles related to energy conversion systems, Combined cycle, Cogeneration system, Steam generator, Steam turbine, Gas turbines, Nuclear power plant, Hydroelectric plant.

Reference Books :

1. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
2. Threlkeld J.L., “Thermal Environmental Engineering”, Prentice Hall
3. Dossat R.J., Principles of Refrigeration, Pearson Education Asia

Reference Books:

1. W.M Kays and M.E. Crawford, “Convective Heat and Mass Transfer”, McGraw Hill Intl.
2. T Cebeci, “Convective Heat Transfer”, Springer
1. W.M Kays and M.E. Crawford, “Convective Heat and Mass Transfer”, McGraw Hill Intl.
2. D. Brian Spalding, “Combustion and mass Transfer’, 1st edition, Pergamon Press, 1979
1. Kenneth K.Kuo, “ Principles of Combustion”, John Wiley and sons. Inc, 2005
2. Irvin Glassman, “Combustion”, Academic Press, 1987
3. Turns,S.R., “An Introduction to Combustion, Concepts and Applications”, Mc-Graw Hill, 2000
4. Williams,F.A., “Combustion Theory” The Benjamin and Cummings Publishing Company Inc.,1985
5. Law,C.K., “Combustion Physics”, Cambridge University Press,2006
1. Wesseling P, “Principles of Computational fluid dynamics”, Springer
2. Ferziger J.H., “Computational methods for fluid dynamics”, Springer 27
3. Anderson, J.D. ”Computational Fluid Dynamics: The Basics with Applications”, McGraw Hill, 1995
4. Ferziger,J.H. and Peric,M., “Computational Methods for Fluid Dynamics”, Springer, 1999
5. Patankar,S.V., “Numerical Heat Transfer and Fluid Flow”, Narosa Publishing House, USA, 1980
6. Date,A.W., “Introduction to Computational Fluid Dynamics”, Cambridge University Press, 2005
7. Wilcox,D.C., “Turbulence Modelling for CFD”, DCW Industries Inc.,1994
8. Chunng,T.J., “Computational Fluid Dynamics”, Cambridge University Press, 2002
9. Thompson,J.F., Warsi,Z.U.A. and C.W. Mastin, “Numerical Grid Generation-Foundations and Applications” North Holland, 1985
1. Stephen B. Pope, “Turbulent flows”, Cambridge Univ. Press
2. Hinze J.O., “Turbulence”, McGraw Hill

Ph.D. Mechanical Engineering Paper-III

Advanced Developments in Design Engineering (Elective-III)

Teaching Scheme	Examination Scheme
Lecturers: 3 Hrs/ Week	Theory: 100 Marks

Unit 1: Mechanical Engineering Design: Load analysis; modes of failure; theories of failure; safety factors; reliability; selection of materials; design of machine elements subjected to static & fatigue loading; shafts; gears; bearings, etc.; design against creep & fracture; Tribological system design.

Unit 2: Advanced Theory of Elasticity (3-dimensional problems):
Theories of Stress and strain, Transformation of stress and strain, Linear stress-strain –temperature relations, Applications of energy methods, Torsion, Bending, Plates

Unit 3: Vibrations
Multi-degree freedom systems, Approximate and numerical methods, Continuous systems, Nonlinear systems

Unit 4: Fracture Mechanics
Linear Elastic Fracture Mechanics,Elastic Plastic Fracture Mechanics, Fracture Mechanisms in Metals

Unit 5: Finite Element Methods
Thermal analysis (temperature effects), 2D, 3D elements,Contact analysis, Non-linear static analysis

Unit 6: Reliability Engineering:
Reliability evaluation of complex systems, Safeties and certifications, Terro technological Aspects

Unit 7: Theoretical & Experimental Stress Analysis: Analysis of three-dimensional state of stress and strain; experimental stress analysis tools like photo-elasticity; strain rosettes; brittle coating; oiré fringes.

Reference Books

1. Boresi A.D., Schmidt R.J, and Sidebottom O.M, “Advanced Mechanics of Materials”, Wiley
2. Richard Budynas, “Advanced strength of applied stress analysis”, McGraw Hill
3. Cook R.D., Young W.C., “Advanced Mechanics of Materials”, Prentice Hall
4. Timoshenko and Goodier, “Theory of Elasticity”, McGraw-Hill Publications
5. M/c standard 8005

6. Kapur K.C., and Lamberson L.R., “Reliability in Engineering Design”, Wiley India Pvt. Ltd., 2009.
7. Bathe K J “Finite Element Procedures”, Cambridge, MA 2007
8. Sequerlind L J, “Finite Element Analysis”, Wiley, 2nd edition, 1984
9. Reddy J.N., “An Introduction to Finite Element Method”, McGraw Hill
   Balakumar Balachandran and Edward Magrab, “Vibrations”, Thomson Brooks/Cole, 2004.
10. Kelly S.G., “Mechanical vibrations”, McGraw-Hill, 2007. T L Anderson, Fracture Mechanics-Fundamentals and Applications, CRC Publishers, 2nd edition, 1995
11. Ashok Saxena, Nonlinear Fracture Mechanics for Engineers, CRC Publications
12. Hertzberg R.W., Deformation and Fracture Mechanics of Engineering Materials, Wiley, 4th edition, 1996.
13. Handbook of air-conditioning system design, Carrier Incorporation,McGraw Hill Book Co., U.S.A.
14. Hainer R.W. ‘Control Systems for Heating, Ventilation and Air – Conditioning’, Van Nastrand Reinhold Co., New York, 1984.
15. Ugural and Fenster, “Advanced Strength and Applied Elasticity”, 4th Ed., Prentice Hall, PTR, 2003.
16. Srinath L.S, “Advanced Mechanics of Solids”, Tata Mc-Graw Hill, New Delhi, 2003.