

जा.क. / शि.वि / अं.म. / 31 🏹

दिनांकः- 416/2024

प्रति,

मा. संचालक, तंत्रज्ञान अधिविभाग, शिवाजी विद्यापीठ, कोल्हापुर मा. प्राचार्य / संचालक, सर्व संलग्नीत अभियात्रिकी महाविद्यालय व इन्स्टिटयुट, शिवाजी विद्यापीठ, कोल्हापुर

विषय : मेकॅनिकल पीएच.डी. कोर्सच्या अभ्यासक्रमाबाबत.. संदर्भ : या कार्यालयाचे पत्र क्र.एसयु/बीओएस/सायन्स — टेक/४७० दि.२६/०६/२०२३.

महोदय,

उपरोक्त संदर्भिय विषयास अनुसरुन आपणास आदेशान्वये कळविण्यात येते की, शैक्षणिक वर्ष २०२३—२४ पासून लागू करण्यात आलेल्या मेकॅनिकल इंजिनिअरींग पीएच.डी. कोर्सवर्क अभ्यासकमामध्ये किरकोळ दुरुस्ती करण्यात आलेली आहे. सोबत सदर अभ्यासकमाची प्रत जोडली आहे. तसेच विद्यापीठाच्या <u>www.unishivaji.ac.in</u> (Online Syllabus) या संकेतस्थळावर ठेवण्यात आला आहे.

सदर अभ्यासकम सर्व संबंधित विद्यार्थी व शिक्षकांच्या निदर्शनास आणून द्यावी ही विनंती. कळावे,

आपला विश्वास एस. एम. कुबल उपकुलसचिव अभ्यास मंडळ विभाग

सोबत : अभ्यासकमाची प्रत.

प्रतः–

- 1. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा
- 2. अध्यक्ष, मेकॅनिकल इंजिनिअरिंग अभ्यास मंडळ
- 3. मा. संचालक, परीक्षा व मुल्यमापन मंडळ
- 4. इतर परीक्षा 4 विभागास.
- 5. परीक्षक नियुक्ती ए व बी विभागास.

यांना माहितीसाठी व पुढील कार्यवाहीसाठी

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STRUCTURE AND SYLLABUS FOR Ph.D. COURSE WORK (MECHANICAL ENGINEERING) June 2023

Modifications in Examination Scheme/ Nature of Question Paper/ Assessment in Paper-2 (Resent Trends in Mechanical Engineering)

1. Theory Examination is to be conducted by the University with duration of 3 hours.

a. Question paper should be set in six sections.

b. Each section will cover separately six units (disciplines/specializations) of Mechanical Engineering given in the course contents.

c. Each section will have 40 marks.

d. Questions from any TWO sections shall be attempted.

2. Internal Examination is to be conducted by the concerned departments or research centers.

Internal evaluation will include 2 seminars of 10 marks each.

3. Separate passing head for Theory Examination and Internal Evaluation

[Minimum: 32 (Theory)+ 8 (Internal Evaluation) = 40]

Ph.D. (Mechanical Engineering) Paper 2: Recent Trends in Mechanical Engineering

Teaching Scheme	Examination Scheme
Total Lecture Hrs.: 40	Theory Examination: 80 Marks
Total Seminar Hrs. : 10	Internal : 20 Marks

Unit 1. Recent Trends in Production Technology

Introduction- solidification of metals – fluid flow – fluidity of molten metal Heat transferdefects- design considerations- Economics of casting- foundry and foundry automation. Metal casting processes, Solid state welding processes, Advanced Machining Processes, Processing of plastics and Composites: Processing methods for plastics, composites, tool making and die making for plastics, composites, Advanced Engineering Materials, Need for high precision, Classes of achievable machining accuracy – normal, precision, high precision and ultra-precision machining; Concept of accuracy – part accuracy, Precision Machining Processes: Classification of material removal processes in terms of the energy source used and the tool-work piece reaction, Diamond turning and milling – machines, tool design and alignment, Fixed abrasive processes - Basic mechanics of grinding, bondless diamond grinding wheels, jig grinding, electrolytic in-process dressing, Ultraprecision grinding, nano-grinding; Loose abrasive processes – polishing, modes of material removal, Chemical mechanical planarization.

Reference Books

- 1. R.M. German, Powder Metallurgy Science, Metal Powder Industries Federation, Princeton, New Jersey
- 2. M.N. Rahaman, Ceramic Processing and Sintering, Marcel Dekker, New York
- Isaacand Daniel M.," Engineering Mechanics of Composite Materials", Oxford University Press, 1994.
- 4. JonesR.M., "MechanicsofCompositeMaterials", McGrawHill, NewYork, 1975
- Calcote L.R., "Analysis of Laminated Composite Structures", Van Nostr and Rainfold, NewYork, 1969
- Murty, R. L. (2009), Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81-224-0750-1

- Venkatesh, V.C. & amp; Izman, S. (2007), "Precision Engineering", (TMH), ISBN: 0-07-062090-3
- Dornfeld, David & amp; Lee, Dae-Eun, (2008), "Precision Manufacturing", (Springer Science + Business Media, LLC), ISBN: 978-0-387-32467-8
- Stephen A. Campbell (1996), "The Science and Engineering of Microelectronic Fabrication", OxfordUniversity Press,

Unit 2. Recent Trends in Manufacturing Systems

Integrated manufacturing systems, Mass Customization, Multi-Product Small Batch Production- Economies of Scope with Diversification; Logistic Systems- Material flow: conversion / transportation / storage, Manufacturing Optimization: Criteria for Evaluation, Optimization of single stage manufacturing- Unit production time and cost; Optimization of multistage manufacturing system, Shop Floor Data Collection Systems, Lean Production, Agile Manufacturing ,Concept of F.M.S, Types and components of FMS, Tests of flexibility, Architecture of typical FMS, Shop Floor Control system, dynamic scheduling in FMS, Flexible Assembly Systems: Basic concepts, classification, planning and scheduling in FAS, Reconfigurable Manufacturing Systems: Definition, goals, elements, rationale, characteristics, principles, RMS and FMS, Concept of system and elements of system, Discrete and continuous system, Models of system and Principles of modeling and simulation, Monte carlo simulation, Types of simulation, Steps in simulation model, Advantages, limitations and applications of simulation, Applications of simulation in manufacturing system

References Books :

- 1. Groover, Mikell P. "Automation, Production Systems & amp; Computer Integrated Manufacturing", Pearson Education or PHI
- Viswanadhan, N. & amp; Narahari, Y., "Performance Modelling of Automated Manufacturing Systems", PHI
- 3. Groover, Michell P. Automation, Production Systems & amp; C.I.M. –3/e, Pearson Education
- 4. Gerard H. Gaynor, "Hand Book of Technology Management", McGraw Hill.
- 5. Willer, "Non- traditional Machining Processes", SME publications.

- 6. Pham Dand Dimov S. (2001), "Rapid manufacturing-The technologies and applications of rapid prototyping and rapid tooling, Springer-Verlag, London,
- 7. Katsudo Hitomi,(1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN81-85617-88-0
- 8. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0
- Simulation Modelling and Analysis / Law, A.M. & Kelton / McGraw Hill, Edition/ New York, 1991.
- 10. Discrete Event System Simulation I Banks J. & Carson J.S., PH I Englewood Cliffs N/ 1984.
- 11. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990. 4. A Course in Simulation / Ross, S.M., McMillan, NY, 1990.
- 12. .Law, A.M. (2007). Simulation Modeling and Analysis, Fourth Edition, McGraw-Hill Book Company, New York.

Unit 3. Recent Trends in Design Engineering

Theory of friction and Wear

Mechanisms of wear, wear resistant materials, Lubrication: Hydrodynamic lubrication, Reynolds equation, Thermal, inertia and turbulent effects, Elasto, Plasto and magneto hydrodynamic lubrication, Hydrostatic, Gas lubrication, Surface

Finite Element Method

Role of finite element analysis in computer-aided design. Mathematical Preliminaries, Differential equations formulations, Variational formulations, weighted residual methods

Advanced Theory of Elasticity (3-dimensional problems)

Transformation of stress and strain, linear stress-strain temperature relations, Applications of energy methods. Torsion, bending, plates

Fracture Mechanics

Linear Elastic Fracture Mechanics, Elastic Plastic Fracture Mechanics, Fracture Mechanisms in Metals

Reference Books:

- 1. Bhushan, B. (2013). Introduction to tribology. John Wiley & amp; Sons.
- 2. Sahoo, P. (2005). Engineering Tribology, PHI Learning Pvt. Ltd.
- 3. 3 Basu, S. K., Sengupta, S. N., & amp; Ahuja, B. B. (2005). Fundamentals of Tribology PHI Learning Pvt. Ltd.
- 4. Majumdar, B. C. (2008). Introduction to Tribology of Bearings. S. Chand Publishing.
- Standard Hand Book of Lubrication Engg., O'Conner and Royle, McGraw Hills C
- 6. Halling, J. (1976). Introduction to tribology. Taylor & amp; Francis Group.
- Salama, K., Taplin, D., Rao, P. R., Ravi-Chandar, K. (2013). Advances in fracture research:Proceedings of the 7th International Conference on Fracture (ICF7), Houston, Texas, 20-24 March 1989. Elsevier.
- 8. Simha, K. R. Y., & amp; Simha, K. (2001). Fracture Mechanics for Modern Engineering design. Universities Press.
- 9. Ugural, A. C., & amp; Fenster, S. K. (2011). Advanced mechanics of materials and applied elasticity.
- 10. Budynas, R. G. (1999). Advanced strength and applied stress analysis.
- 11. Cook, R. D. (2001). Concepts and applications of Finite element Analysis. John Wiley & amp;Sons.
- 12. Reddy. (2005). An Int. To The Finite Element. Tata McGraw-Hill Education.
- 13. Timoshenko, S. (1970). Theory of elasticity.
- 14. Timoshenko, S. P. (2004). Strength of materials: Elementary theory and problems.
- Budynas, R., & Nisbett, K. (2008a). Shigley's Mechanical Engineering design. McGraw-Hill Science/Engineering/Math.. Ltd.
- Dieter, G. E. (1983a). Engineering design: A Materials and Processing Approach. McGraw-Hill Science, Engineering & amp; Mathematics.
- Boresi, A. P., & amp; Schmidt, R. J. (2002). Advanced Mechanics of Materials. John Wiley & amp; Sons.
- 18. Popov, E. P., & amp; Balan, T. A. (2018). Engineering Mechanics of Solids.
- Beer, F. P., Johnston, E. R., DeWolf, J. T., Mazurek, D. F., & amp; Sanghi, S. (2017). Mechanics of materials.
- 20. Hibbeler, R. C. (2005). Mechanics of materials. Prentice Hall.

- 21. Subramanian, R. (2010). Strength of materials. Oxford University Press, USA.
- 22. Broek, D. (2012). Elementary engineering fracture mechanics. Springer Science & amp; Business Media.
- 23. Anderson, T. L., & amp; Anderson, T. L. (2005). Fracture Mechanics: Fundamentals and Applications Third Edition. CRC Press.
- 24. R.J. Atkin and N. Fox, 2005, an Introduction to the Theory of Elasticity. Dover, NY.
- 25. Anderson, Fracture Mechan10. Billinton, R. (1970). Power System Reliability Evaluation. Taylor & amp; Francis.

Unit 4. Recent Trends in Machine Design

Micro Electro Mechanical Systems (MEMS)

From Microphysics to Macrophysics, Thermodynamics of Microstructures, Reliability of MEMS

Bio-medical Device Design

Applications, FDA approval procedures, Certification and Classification,

Vibrations, Acoustics and Harshness

Multi-degree freedom systems, Approximate and numerical methods, Continuous systems, Nonlinear systems, Wave propagation, generation/transmission of sound, noise control, Frequency and wavelength, simple harmonic motion, superposition of waves, sound waves, acoustical properties and levels Introduction to NVH, Sound and vibration theory, Test facilities and instrumentation, Signal Processing techniques, NVH control Strategies

System Design

Systems design for Cooling of Electronic Equipment's Enclosure design, power packing factors, electronic packing.

Reference Books :

- 1. Craig, J. J. (2005). Introduction to robotics: Mechanics and Control. Addison-Wesley Longman.
- 2. Ebeling, C. E. (2010). An introduction to reliability and maintainability engineering.
- 3. Gatzen, H. H., Saile, V., & amp; Leuthold, J. (2015). Micro and nano fabrication: Tools and Processes. Springer.

- 4. King, P. H., Fries, R. C., & amp; Johnson, A. T. (2014). Design of Biomedical Devices and Systems, third edition. CRC Press.
- Mahalik. (2003). Mechatronics: Principles, Concepts and Applications. Tata McGraw-Hill Education.
- 6. Ogrodnik, P. J. (2012). Medical device design: Innovation from Concept to Market. Academic Press.
- Webster, J. G. (2009). Medical instrumentation: Application and Design. John Wiley & amp;Sons.
- 8. Juvinall, R. C., & amp; Marshek, K. M. (2020a). Fundamentals of Machine component Design.John Wiley & amp; Sons Pearson Education.
- Tribology Hand Book, Michel Ncolics: Fundamentals and Applications, CRC press, 3rd Ed., 2005
- Andrianov, I., Gluzman, S., & Mityushev, V. (2022). Mechanics and Physics of Structured Media: Asymptotic and Integral Equations Methods of Leonid Filshtinsky. Academic Press.
- 11. Hill, R. (1998). The Mathematical Theory of plasticity. Oxford University Press.
- 12. Dimarogonas, A. D. (1996). Vibration for engineers.
- 13. Meirovitch, L. (1986). Elements of vibration analysis.
- 14. Rahn, C. D. (2013). Mechatronic control of distributed noise and vibration: A Lyapunov
- 15. Approach. Springer Science & amp; Business Media.
- 16. Thomson, W. (2018). Theory of Vibration with Applications. CRC Press.

Unit 5. Recent Trends in Heat Power Engineering

Advanced Thermodynamic Cycles, Boiling and condensation heat transfer in micro channels, Compact heat exchangers for enhanced heat transfer, Nanostructured materials for enhanced heat transfer, Advanced Refrigeration and Air Conditioning, Flameless combustion technologies for reduced emissions, Alternative Fuels for IC Engines, Advanced materials for high-temperature applications in gas turbines and boilers, Advanced Computational Fluid Dynamics (CFD) Simulations.

Reference Books:

1. Supercritical Fluids: Fundamentals and Applications & quot; by K. S. Birdi.

2. Combined-Cycle Gas & amp; Steam Turbine Power Plants & quot; by Rolf Kehlhofer, Bert Rukes, and Francis Vanek.

3. Organic Rankine Cycle (ORC) Power Systems: Technologies and Applications & quot; by Ennio Macchi et al.

4. Convective Boiling and Condensation & quot; by John R. Thome. Nanostructured materials for enhanced heat transfer:

5. Nanofluids: Fundamentals and Applications & quot; by Arvind Pattamatta.

6. Computational Fluid Dynamics: Principles and Applications & quot; by Jiri Blazek.

7. Compact Heat Exchangers: Selection, Design, and Operation & quot; by J.E. Hessel greaves. Microscale heat exchangers for compact and efficient systems:

8. Microscale Heat Transfer - Fundamentals and Applications & quot; by S. Kakaç and Y. Yener. Heat exchangers with phase-change materials (PCMs) for thermal energy storage:

9. Heat Exchangers: Selection, Rating, and Thermal Design" by Sadik Kakac and HongtanLiu.

10.Heat Exchanger Design Handbook" by Kuppan Thulukkanam.

11. Stoecker W. F. and Jones J. P., Principles of Refrigeration and air-conditioning, McGrawHill

12. Flameless Combustion" by U. Maas and R. A. Shaw.

13. Alternative Fuels for Transportation" by A.S. Ramadhas, S. Jayaraj, and L.Muraleedharan.

14. M.K. Gajendra Babu, K.A. Subramanian, Alternative Transportation Fuels: Utilization in Combustion Engines, CRC Press, 2013.

15. Advanced Materials for High Temperature Key Technologies for the Future" by Martin Heilmaier and Guenter Gottstein.

16. Nanofluids: Science and Technology" by Sarit K. Das.

Unit 6. Recent Trends in Thermal Engineering

Advanced technologies for waste heat recovery in industrial processes, Advanced Control and Optimization, Life cycle assessment (LCA) of heat power systems, Optimization of heat power systems with machine learning and artificial intelligence Advanced thermal energy storage systems, Low-Carbon and Net-Zero Emission Power Generation, Carbon Capture and Utilization (CCU) in Power Generation, Techno-Economic Analysis for Sustainable Heat Power Solutions

Reference Books:

- Waste Heat Recovery: Technologies and Applications & quot; by Ibrahim Dincer and Calin Zamfirescu.
- Combined Heat and Power: Generating Heat and Electricity efficiently & quot; by Paul Breeze. Integration of heat power systems in the circular economy:
- Industrial Ecology and Sustainable Engineering & quot; by T.E. Graedel and B.R. Allenby. Environmental Impact and Sustainability
- 4. Model Predictive Control" by Eduardo F. Camacho and Carlos Bordons. Advanced control strategies for grid integration and load balancing:
- 5. Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.
- 6. Life Cycle Assessment: Theory and Practice" by Michael Z. Hauschild and Ralph K.Rosenbaum.
- 7. Low Carbon Energy in North America: Progress and Challenges & quot; by Yves Gagnon and Louis Barriault.
- Techno-Economic Paradigms: Essays in Honour of Carlota Perez & quot; edited by Jan Fagerberg and Stan Metcalfe.
- Thermal Energy Storage Systems and Applications & quot; by Ibrahim Dincer and Marc A.Rosen.
- Advances in Concentrating Solar Thermal Research and Technology & quot; edited by ManuelBlanco et al.
- Carbon Capture and Utilization in Power Generation and Process Industries & quot; by
 B. V. Reddy.