ANNEXURE-2

SHRI VISHWAKARMA SKILL UNIVERSITY

(A STATE GOVT SKILL UNIVERSITY ESTABLESHED BY GOVT.OF HARYANA)

Name of the Skill Faculty: Skill Faculty of Engineering & Technology

Name of the Programme/Course: Ph. D Programme under Skill Department of Automotive Studies

Ph.D Course Work

Batch: **2020-21 (onwards)**

Syllabus

for

Ph.D Programme

Batch (2020-21) onwards

Structure of Materials

Subject Code: ME-1001

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

The course objective of this course is to provide opportunity to the students to understand the materials and alloys formation, Solidification of metals and alloys, phase transformations, laws of diffusion, Binary systems.

Learning Outcomes

- Understanding about materials and formation of alloys
- Understanding about the phase diagrams and solidification concept of metals and alloys
- Understanding about the correlations of diffusion in solids and binary systems of different materials.

Unit	Topic	Key Learning
I	**Introduction to Materials and principlesof Alloy Formation (08 hrs)**	Primary and intermediate phases their formation, solid solutions, Hume Rothery rules, electron compounds, normal valency compounds and interstitial compounds.
II	**Solidification and Phase Diagrams (09 hrs)**	Solidification of metals and alloys- equiaxed, dendritic and columnar grains; Coring. Binary equilibrium diagrams involving isomorphous, eutectic, peritectic and monotectic systems, phase rule, leverrule effect of non-equilibrium cooling on structure and distribution of phases
III	**Solid State Transformations (09 hrs)**	Phase equilibria involving eutectoid and peritectoid transformations, TTT and CCT diagrams, harenability, Heat Treatment of Ferrous and Non Ferrous Alloys viz.,annealing, normalizing, quenching, tempering and precipitation hardening.
IV	**Diffusion in Solids (10 hrs)**	Fick's laws of diffusion, Darken's equation, Kirkendall effect and mechanism of diffusion
V	**Important Binary Systems (08 hrs)**	Cu-Ni, Al-Si, Al-Cu, Pb-Sn, Cu-Zn, CuSn and Fe-Csystems, effect of non equilibrium cooling and important alloys belonging to these systems.

Instructional Strategies:

Lecture, Discussion, Presentation, Case Study, Seminar/presentation by student, Assignment and projects, Demonstration and learning by doing.

Internal assessment of 30% component will be on continuous basis and External assessment of 70% component shall be held as per examination ordinance of the university.

Text Books:

- Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill
- Callister W.D., Materials Science and Engineering, Wiley India (P) Ltd.

Reference Books:

- Hansen, P. Mordike, B.L., "Physical Metallurgy", Cambridge University Press
- H. Chandler, Heat Treater's Guide: Standard Practices for Irons and Steels, ASM International
- Hosford. W.F, "Physical Metallurgy", CRC Press.
- Smallman, R.E., Ngan, A.H.W., Modern Physical Metallurgy, Butterworth-Heinemann.

Tribology of Materials

Subject Code: ME-1002

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

The course objective of this course is to provide opportunity to learn surface treatment techniques, tribological properties of materials and wear phenomena of materials.

Learning Outcomes

- Understanding of tribological processes and tribologically relevant properties of materials
- Understanding of surface treatment techniques and surfaces
- Understanding about the wear mechanisms and types of erosion

Unit	Topic	Key Learning
I	**Introduction to Tribology Materials (10hrs)**	Introduction to tribological processes and tribologicallyrelevant properties of materials, friction materials and their application. Wear resistant materials.
II	**Surface treatment Techniques and surfacesin contact (11 hrs)**	Surface treatment techniques with applications such as carburising, nitriding, induction hardening, hard facing and laser surface treatments. Surface coating techniques such as electrochemical depositions, anodizing, thermal spraying, Chemical vapour deposition. Quantifying surfaceroughness, contact between surfaces; the laws of friction
III	**Tribological propertiesof solid materials (12 hrs)**	Hardness, strength, ductility and work hardening rate, effect of crystal structure, effect of microstructure, mutualsolubility of rubbing pairs and effect of temperature
IV	**Wear Mechanism (12 hrs)**	Types of wear, adhesive wear, Archard's law, abrasive wear,erosion wear, factors affecting corrosive wear, wear map, various wear testing methods- pin on disc, pin on drum, slurry wear, air jet and water jet erosion as per ASTM standards

Instructional Strategies:

Lecture, Discussion, Presentation, Case Study, Seminar/presentation by student, Assignment and projects, Demonstration and learning by doing.

Internal assessment of 30% component will be on continuous basis and External assessment of 70% component shall be held as per examination ordinance of the university.

Text Books:

- Hutchings I.M., Tribology – Friction and wear of engineering Materials, Edward Arnold
- Arnold R.D., Davies P.B., Halling J. and Whomes T.L., Tribology – Principles and Design Applications, Springer Verlag
- Bhushan B., Introduction to Tribology, John Wiley

Reference Books:

- Stachowiak G and Batchelor A.W., Engineering Tribology, Elsevier Butterworth-Heinemann
- Tribological Design of Machine Elements by D. Dowson, C.M. Taylor, M. Godet, D.Berthe.
- Archard J F and Hirst W, The Wear of Metals under Unlubricated Conditions, Proc. R.Soc., London, A 236, 397-410
- Ludema K C, Friction, Wear, Lubrication: A textbook in Tribology, CRC Press

Advance Manufacturing Processes

Subject Code: ME-1003

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

The course objective of this course is to learn advancements in machining, casting, metal forming and welding processes.

Learning Outcomes

- Understanding of advance machining processes and their parametric analysis
- Understanding of different types of casting and metal forming processes
- Knowledge of different type of welding processes and their process parameters

Unit	Topic	Key Learning
I	**Introduction to Advance Machining Processes (14 hrs)**	Introduction to advance machining processes, Process principle, Material removal mechanism, Parametric analysis and applications of processes such as ultrasonic machining, Abrasive jet machining, Water jet machining, Abrasive water jet machining, Electrochemical machining, Electro discharge machining, Electron beam machining and Laser beam machining processes
II	**Advanced Casting Processes (10 hrs)**	Metal mould casting, Continuous casting, Squeeze casting, Vacuum mould casting, Evaporative pattern casting and Ceramic shell casting
III	**Advanced Metal Forming Processes (11 hrs)**	Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming
IV	**Advanced Welding Processes (10 hrs)**	Details of electron beam welding (EBW), laser beam welding (LBW), ultrasonic welding (USW), Solid Phase Joining and Processing

Instructional Strategies:

Lecture, Discussion, Presentation, Case Study, Seminar/presentation by student, Assignment and projects, Demonstration and learning by doing.

Internal assessment of 30% component will be on continuous basis and External assessment of 70% component shall be held as per examination ordinance of the university.

Text Book:

- "Materials and Processes in Manufacturing", E.P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).
- "Manufacturing Science" A. Ghosh, and A.K. Mallik, Affiliated East-West Press Pvt. Ltd.New Delhi.

Reference Books:

- "Nontraditional Manufacturing Processes", G.F. Benedict, Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7).
- Non-Traditional and Advanced Machining Technologies, Helmi Youssef and Hassan El-Hofy

Welding in Automobiles

Subject Code: ME-1004

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

The course objective of this course is to learn advancements in the field of welding techniques used in automobile industries, welding defects and their remedies.

Learning Outcomes

- Understanding of different types of welding used in automobile sector.
- Understanding of the welding techniques used for welding of ferrous and non-ferrous materials.
- Knowledge of fusion and non-fusion technologies used in automobile industry.

Unit	Topic	Key Learning
I	**Introduction to Welding in Automobiles (09 hrs)**	Requirement of welding in automobiles, Welded components and types of welding used, Challenges in welding in automobiles, Similar and dissimilar welding, Tailored welded blanks, Formability of the welded components.
II	**Welding of Ferrous and Non-ferrous alloys (09 hrs)**	Ferrous and non-ferrous components in automobiles, Suitabilityand non-suitability of specific welding process in ferrous and non-ferrous alloys. Factors deciding the weld- ability.
III	**Common Welding Defects, Causes and Remedies (08 hrs)**	Residual stress, distortion, and Fatigue of welded parts. Porosity, Weld Crack, Undercut, Incomplete Fusion, Incomplete Penetration, Incomplete Penetration, Slag Inclusion, Spatter.
IV	**Non-fusion welding techniques used in automobile (09 hrs)**	Solid state welding vs fusion welding, Working principle of FSW, Process parameters controlling the weld quality, Friction Stir Spot Welding (FSSW), Microstructure of FS Wed joints.
V	**Fusion welding techniques used in automotive industries (10 hrs)**	Working principle, advantages and limitations of laser beam welding, GMAW, GTAW, and RSW, modes of metal transfer in GMAW, polarity of GTAW, Conduction Mode vs. Keyhole Mode Laser Welding

Instructional Strategies:

Lecture, Discussion, Presentation, Case Study, Seminar/presentation by student, Assignment and projects, Demonstration and learning by doing.

Internal assessment of 30% component will be on continuous basis and External assessment of 70% component shall be held as per examination ordinance of the university.

Text Book:

- American Welding Society, Welding Handbook - Welding Processes Part 2, Vol. 3, AWS.
- W Steen, Laser Material Processing, Springer-Verlag.
- ASM International Handbook Committee, Welding, Brazing and Soldering, ASM handbook,Vol 6.

Reference Books:

- L. Liu, Welding and Joining of Magnesium Alloys, Woodhead Publishing.
- J. Norrish, Advanced welding Processes, Woodhead publishing.
- L. E Lindgren, Computational welding mechanics, Woodhead Publishing Limited.
- J. A. Goldak, Computational welding mechanics, Springer

Optimization and Heuristic Search Techniques

Subject Code: EE-1001

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

The objective of this course is to develop a knowledge in the field of optimization problem, basic optimization issues, modern optimization techniques and various heuristic optimization techniques.

Learning Outcomes: After completion of the course, student will be able to:

- Learn about optimization problem and basic optimization issues
- Apply modern optimization methods for solving optimization problems
- Acquire knowledge about various heuristic optimization techniques
- Apply optimization algorithms for engineering applications

Unit	Topic	Key Learning
I	**Introduction to Optimization (12 hrs)**	Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality
II	**Modern methods of Optimization (12 hrs)**	Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of MATLAB to solve optimization problems.
III	**Heuristic Optimization techniques (11 hrs)**	Meta heuristic search methods: Genetic Algorithm based optimization, Gravitational Search Algorithm, PSO, etc.
IV	**Applications of Optimization Algorithms (10 hrs)**	Engineering application of Optimization techniques

Instructional Strategies:

Lecture, Discussion, Presentation, Case Study, Seminar/presentation by student, Assignment and projects, Demonstration and learning by doing.

Internal assessment of 30% component will be on continuous basis and External assessment of 70% component shall be held as per examination ordinance of the university.

Text Book:

- Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age InternationalPublishers
- "Modern Heuristic Optimization Techniques" by Kwang Y. Lee, Mohamed A. El-Sharkawi
- "Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer (India), Pvt. Ltd.

Reference Books:

- "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C. Mohan, New Age International (P) Limited, Publishers
- Operations Research – by Dr. S.D.Sharma.
- "Operations Research: An Introduction" by H.A. Taha, PHI Pvt. Ltd.
- Deb K. - 'Optimization for Engineering Design Algorithms and Examples' – PHI