COURSE CONTENT

MECHANICAL BEHAVIOUR OF MATERIALS								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD10	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorials Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Pre requisites: Elements of Mechanical Engineering								

I. COURSE OVERVIEW:

The basics of material structures and properties and strength of materials, shall be introduced to dislocation theories of plasticity behavior, various strengthening mechanisms. Emphasis on analytical and numerical methods for predicting material properties and behavior, as well as some discussion of the relationships between solid structure and material properties. Topics include: fracture, fatigue, plasticity, creep and deformation.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concept of fracture and its types, fracture curve and fracture mechanics.
II. The theory of elasticity and plasticity fracture mechanics and effects of deformation of various metals and polymers.
III. The effect of Mean stress, crack propagation and surface effects on Fatigue.
IV. The evolution of creep damage and Micro mechanisms of creep in materials.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1 Recall the fundamentals of fracture and creep
CO2 Illustrate the importance of various materials and its application in an industry.
CO3 Summarize the importance of materials and their characteristics.
CO4 Explain the concept of fracture mechanics and Griffith theory of Brittle materials
CO5 Apply stress – strain relation in elasticity and plasticity behavior of metals and polymers
CO6 Develop S-N Curve and relate Stress Cycles on Fatigue.

IV.COURSE CONTENT:

MODULE -I: Fracture Introduction (09)

Introduction, Types of Fracture in Metals, Griffith Theory of Brittle Fracture, Fracture of Single Crystals, Ductile Fracture, Concept of the Fracture Curve. Fracture Mechanics: Strain Energy Release rate, Fracture Toughness and Design, Crack Opening Displacement, J-Integral, R Curve.

MODULE -II: Linear Elastic Fracture Mechanics (10)

Theory of Elasticity and Plasticity: Elasticity Theory: The State of Stress and strain, elastic stress-strain relation, anisotropy, elastic behavior of metals, ceramics and polymers. Plasticity: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria and yield surface, texture and distortion of yield surface, true stress and true strain, flow rules, strain hardening, Ramberg Osgood equation, stress -strain relation in plasticity, plastic deformation of metals and polymers.

MODULE -III: Fatigue-I (10)
Introduction, Stress Cycles, S-N Curve, Effect of Mean Stress on Fatigue, Cyclic Stress strain curve, Low Cycle Fatigue, Strain Life Equation. Structural Features of Fatigue, Fatigue Crack Propagation, Effect of Metallurgical Variables on Fatigue.

MODULE -IV: Fatigue-II (09)
Effect of stress concentration on Fatigue, Size Effect, Surface effects on Fatigue, Fatigue under Combined stresses, Design for Fatigue, Machine Design Approach-Infinite life design, Local strain approach, Corrosion Fatigue, Effect of Temperature on fatigue.

MODULE -V: Creep Deformation (10)
The evolution of creep damage, primary, secondary and tertiary creep, Micro mechanisms of creep in materials and the role of diffusion, Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters, Creep-fatigue interactions, Examples.

V. TEXT BOOKS:
1. G. E. Dieter, "Mechanical Metallurgy", McGraw Hill, 3rd edition, 2017.
2. L.B. Freund, S. Suresh Thin Film Materials, Cambridge University Press, 1st edition, 2013.

VI. REFERENCE BOOKS:
1. T.L. Anderson, "Fracture Mechanics Fundamentals and Applications", CRC press, 2nd edition, 2013.
2. B. Lawn, "Fracture of Brittle Solids", Cambridge Solid State Science Series, 2nd edition, 2013
3. J.F. Knott, "Fundamentals of Fracture Mechanics", Butter worths & Co Publishers Ltd, 1st edition, 2013.
4. S. Suresh, "Fatigue of Materials", Cambridge University Press, 1st edition, 2013.

VII. WEB REFERENCES:
1. http://nptel.ac.in/courses/113/106/113106101/

VIII. E-TEXT BOOK:
1. http://3gaam.com/content/uploads/manual/mechanical-metallurgy-dieter.pdf

IX. MATERIALS ONLINE
1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. PowerPoint presentation