Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Mechanical Engineering

BME403-INDUSTRIAL METALLURGY
Fourth Semester, 2015-16 (Even Semester)

Course (catalog) description

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

Compulsory/Elective course : Core Subject for mechanical Engineering

Credit & hours : 03 & 45 Hrs

Course Coordinator : Mrs.Suchitra

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
R.Sharavanan	2A	JR101		sharavananr.mech@bharathuniv.ac.in	11.40 to 12.30 pm
S. Manavalan	2B	JR102		manavalan.mech@bharath.univ.ac.in	2.20 to 3.10 pm
J. Manikandan	2C	JR103		manikandan.mech@bharathuniv.ac.in	10.50 to 11.30 am

Relationship to other courses:

Pre –requisites **:** Manufacturing Technology

Assumed knowledge : It helps the students to understand material behavior of metals,strengthening mechanism, fracture and flaws in metallographic in ferrous and non Ferrous metals

Following courses : Nil

Syllabus Contents

UNIT I CRYSTALLOGRAPHY 9

Structure of metals and alloys – Molecules and bonding – Crystal structure inter atomic distance and ionic radii, polymorphism, Miller indices of atomic planes, Bragg's law, crystal defects – point, line and plane defects – Effect of crystal imperfection on mechanical properties- strengthening mechanism for improvement of mechanical properties – Allotropy, grain and grain boundaries – problems.

UNIT II MECHANICAL PROPERTIES AND ELASTIC DEFORMATION 9

Mechanical properties: Stress strain curve- elastic deformation – characteristics of elastic deformation – Atomic mechanism of elastic deformation – elastic deformation of an isotropic material – Modulus of elastic resilience. Elastic deformation: strain time curves – Damping capacity – viscous deformation – Plastic deformation – Dislocation and stress – strain curves, Schmid's law. Critical resolved shear stress, Work hardening, Grain boundary hardening, solution hardening, Dispersion hardening.

UNIT III FRACTURE AND ITS PREVENTION 9

Mechanism of brittle fracture – ideal fracture stress (Griffith's theory) – Ductile fracture- Difference between brittle and ductile fracture – fracture toughness – Cup and cone type of fracture – fatigue failure and its prevention – Creep – various stages in creep curve – factors affecting creep resistant materials – Mechanism of creep fracture.

UNIT IV METALLURGY, FERROUS AND NON FERROUS ALLOYS 9

Metallurgy: Solid solution – Intermetallic compound – Cooling curves – Non equilibrium – Phase rule – Interpretation of equilibrium diagram of Cu-Ni, Cu –Zn, Cu – Sn, Cu –Al.Ferrous alloys: Phase diagram and its significance – Allotropy and phase change of pure iron – steel and cast iron classifications – Equilibrium diagram for iron –Carbon, Microstructure representation for iron and steel – Application of ferrous alloys – Factors affecting mechanical properties. Heat treatment: Definition – annealing and normalizing. Types of annealing.TTT diagram – cooling curves superimposed on I.T. diagram.Hardenability, Jominy end quench test, Austempering, mar tempering.

UNIT V SURFACE ENGINEERING 9

Surface heat treatment – Diffusion methods – Carburizing – Nitriding – Cyaniding and carbonitriding – Applications – Thermal methods – flame hardening – induction hardening and their applications – Laser surface hardening–Vickers's Hardness test.

Total : 45 Hours

TEXT BOOKS:

1. G.E.Dieter, Mechanical Metallurgy, McGraw Hill ISE, 1999.
2. Raghavan, Material Science and Engineering, Prentice Hall of India Pvt. Ltd., 2004.

REFERENCES:

1. D.Callister-Material Science And Engineering.
2. Arumugam, M.Material Science, Anuradha Publishers, 1997.
3. R.A.Flinn & P.K.Trojan, Engineering Materials and their Applications
4. Rajan, T.V. Sharma and Ashok Sharma, Heat Treatment – Principles and their techniques, Prentice Hall of India Pvt. Ltd., 2004. 5. www.studynama.com/.../315-Engineering-materials-metallurgy-lecture-n...

Computer usage: Nil

Professional component

General	-	0%
Basic Sciences	-	30%
Engineering sciences & Technical arts	-	30%
Professional subject	-	40%

Broad area : Materials & Metallurgy

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	February 2nd week	Session 1 to 14	2 Periods
2	Cycle Test-2	March 2nd week	Session 15 to 28	2 Periods
3	Model Test	April 3rd week	Session 1 to 45	3 Hrs
5 1	University Examination Cycle Test-1	TBA February 2nd week	All sessions / Units Session 1 to 14	3 Hrs. 2 Periods

Mapping of Instructional Objectives with Program Outcome

Course Outcomes (COs)	Correlates to program outcome		
	H	**M**	**L**
CO1- Upon completion of this course, the students will be able to differentiate materials, their processing, heat treatments in suitable application of mechanical engineering field.	a,b,k,l	h,i	c
CO2- Student gain knowledge in selecting materials	a,b,k,l	h,i	c
CO3- Understand mechanical properties of materials	a,b,k,l	h,i	-
CO4 - Understand crystallography techniques	a,k,l	b,h,i	c
CO5 - Learn surface engineering techniques	b	a,h,i,k,l	c
CO6 - Understand fracture and learn to get rid of it.	b	a,h,i,k,l	c

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I			
1.	Structure of metals and alloys	No	T1,T2,R1
2.	Crystal structure of inter atomic and ionic radii	Yes	
3.	Miller indices and Bragg's law for crystal structure	Yes	
4.	Crystal Imperfections on Mechanical properties	No	
5.	Point, Line and Plane Defects	No	
6.	Allotropy of crystallography of metals	Yes	
7.	Molecules and bonding of crystals	No	
8.	Polymorphism of Alloys	No	
UNIT II			
9.	Mechanism of plastic deformation, slip and twinning	No	T1,T2,R1,R2
10.	Testing of materials under tension, compression and shear loads	Yes	
11.	Hardness tests – Brinell test	Yes	
12.	Atomic Mechanism,Modulus of resilience	No	
13.	Stress strain curves	No	
14.	Viscous deformation	No	
15.	Plastic deformation of different forms of metals	No	
16.	Dislocation of stress strain curves	No	
17.	Schmid's Law	No	
18.	Work Hardening-Solution and Dispersion hardening	Yes	
UNIT III			
19.	Types of fracture	No	T1,T2,R1,R3
20.	Griffth Theory for fracture metals	No	
21.	Ductile and Brittle Properties for alloys and metals	No	
22.	Toughness in fracture	No	
23.	Fracture defects – Cup and Cone	No	
24.	Creep - curves	No	
25.	Factors affecting creep resistant materials	No	
26.	Mechanism of creep fracture	Yes	
27.	Problems based on fracture	Yes	
UNIT IV			

28.	Constitution of Alloys,Solid solution	No	T1,T3,R1,R2,R3
29.	Substitutional and interstitial – phase diagrams	No	
30.	Isomorphous, eutectoid, eutectic, reactions	No	
31.	Peritectic, and peritectroid reactions	No	
32.	Iron – Iron carbide equilibrium diagram	No	
33.	Classification of steel and cast Iron, Microstructure, properties	No	
34.	Full annealing, stress relief, recrystallisation and spheroidizing	No	
35.	Normalising, hardening and tempering of steel	No	
36.	Isothermal transformation diagrams	No	
37.	Cooling curves superimposed on I.T. diagram	No	
38.	Austempering, martempering, Flame and induction hardening	No	
39.	Case hardening – carburising, nitriding, cyaniding, carbonitriding	No	
UNIT V			
40.	Definition – Full annealing, stress relief, recrystallisation and spheroidizing	No	T1,T2,R1,R2
41.	Isothermal transformation diagrams	No	
42.	Hardness tests – Rockwell test	No	
43.	Hardness tests – Vickers 35 test	No	
44.	Impact test – Izod and Charpy	No	
45.	Case hardening – carburising, nitriding, cyaniding, carbonitriding	No	
46.	Flame and induction hardening	No	
47.	Laserr hardening	No	
48.	Diffusion Methods	No	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment / Seminar / Online Test / Quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by : Mrs.Meenakshi Dated :

Addendum

ABET Outcomes expected of graduates of B.Tech / MECH / program by the time that they graduate:

a) The ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) The ability to identify, formulate and solve engineering problems.

c) The ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) The ability to design and conduct experiments, as well as to analyze and interpret data

e) The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) The ability to apply reasoning informed by the knowledge of contemporary issues.

g) The ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) The ability to understand professional and ethical responsibility and apply them in engineering practices.

i) The ability to function on multidisciplinary teams.

j) The ability to communicate effectively with the engineering community and with society at large.

k) The ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) The ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION:
Mechanical Engineering graduatesare enthusiastic to provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Mechanical Engineering.

PEO2: CORE COMPETENCE:
Mechanical Engineering graduates have competence to enhance the skills and experience in defining problems in the field of Mechanical Engineering and Technology design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:
Mechanical Engineering graduates made competence to enhance their skills and embrace new thrust areas through self-directed professional development and post-graduate training or education.

PEO4: PROFICIENCY:

Mechanical Engineering graduates became skilled to afford training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:

Mechanical Engineering graduates are morally merged to apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

BME403-INDUSTRIAL METALLURGY

Course Teacher	**Signature**
R.Sharavanan	
S. Manavalan J. Manikandan	

Course Coordinator **HOD/MECH**

Mrs.Suchitra