Academic Course Description
BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Mechanical Engineering
BME 008 MECHANICS OF FRACTURE
Seventh Semester, 2015-16 (Odd Semester)

Course (catalog) description
The purpose is to give an introduction about fundamental theory in facture mechanics. Knowledge of failure mechanisms and the fracture mechanics is important in many fields of research and industrial applications.

Compulsory course **:** Elective

Credit & contact hours : 3 & 45

Course Coordinator : Mr.Arun V Rejus Kumar

Instructors **:**
Relationship to other courses:

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Mr.Arun V Rejus Kumar	VII sem	JR 002	22290125	Arunrejus.mech@bharathuniv.ac.in	11.40 -12.30 PM
S.Thirumavalavan	VII sem	JR003,004		Thirumavalavan.mechmech@bharathuniv.ac.in	10.50 - 11.40 AM

Pre –requisites **:** Machine Design I
Assumed knowledge : To expose the students to understand the concepts of machine desing and various failures

Following courses : nil

Syllabus Contents

UNIT I INTRODUCTION &ELASTIC CRACK 9

Introduction-Crack in a structure-Griffith criterion cleavage fracture, ductile fracture, fatigue cracking Service failure analysis. Elastic crack-Elastic crack tip stress field- Solution to crack problems, Effect of finite size stress intensity factor-Special cases- Irwin plastic zone correction – Actual shape of plastic zone-plane stress- plane strain

UNIT II ENERGY PRINCIPLE 9

Energy release rate- criterion for crack growth- Crack resistance curve-Principles of crack arrest- Crack arrest in practice.

UNIT III FATIGUE CRACK GROWTH 9

Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor-variable amplitude service loading, retardation model.

UNIT IVELASTIC PLASTIC FRACTURE MECHANICS 9

Elastic plastic fracture concepts- crack tip opening displacement- J using FEM.

UNIT V APPLICATIONS OF FRACTURE MECHANICS 9

Fracture design- selection of materials-Fatigue crack growth rate curve- stress intensity factor range- Use of crack growth law.

Total : 45 Hours

TEXT BOOKS:

1. Jean lemative and Jean Louis chboche "Mechanics of solid Materials," Cambridge university press, Cambridge, 1987.

2. Prashant Kumar, Elements of fracture mechanics, wheeler publishing, 1999.

REFERENCES: 1.John M.Barsom and Stanley T Rolfe, "Fracture and fatigue control in structures", Prentice Hall, Inc, USA, 1987.

2.David Broek- "Elementary engineering fracture mechanics" Martinus Nijh off publishers, 1982.

3.https://apm.iitm.ac.in/smlab/kramesh/book_4.htm

Computer usage:

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100%

Broad area : Machine design and failure

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 3nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

The purpose is to give an introduction about fundamental theory in facture mechanics. Knowledge of failure mechanisms and the fracture mechanics is important in many fields of research and industrial applications.	Correlates to program outcome		
	H	**M**	**L**
1. The student will develop skills in deriving stress field and energy release rate around the crack tip and crack propagation under cyclic loading.	a		
2. Learn about crack failures	c		
3. Understanding of fracture mechanics and its application		g	k
4. Learn about fatigue growth	a,c,d	e,f	l
5. Will learn about fracture failure			l
6. modes Learn fracture repair and analysis	a		l

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

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT – I **INTRODUCTION &ELASTIC CRACK**			
1.	Introduction-Crack in a structure	no	(T2) Chapter 1 (R1) Chapter 1 Chapter 2
2.	Griffith criterion cleavage fracture	no	
3.	ductile fracture	no	
4.	fatigue cracking	no	
5.	Service failure analysis	no	
6.	Elastic crack-Elastic crack tip stress field	no	
7.	Solution to crack problems	no	
8.	- Irwin plastic zone correction	no	
9.	Actual shape of plastic zone- plane stress- plane strain	no	
UNIT – II **ENERGY PRINCIPLE**			
10.	Energy release rate	no	(T2) Chapter 10 (R1) Chapter 5
11.	Energy release rate	no	
12.	criterion for crack growth	no	
13.	criterion for crack growth	no	
14.	criterion for crack growth	no	
15.	Crack resistance curve	no	
16.	Principles of crack arrest	no	
17.	Principles of crack arrest	no	
18.	Crack arrest in practice.	no	
UNIT – III **FATIGUE CRACK GROWTH**			
19.	Fatigue crack growth test,	no	(T2) Chapter 11 (R1) Chapter 7
20.	stress intensity factor,	no	
21.	factors affecting stress intensity factor-	no	
22.	Hydraulic circuit for surface grinding	no	
23.	Hydraulic circuit for vertical milling machine	no	
24.	Forklift, Hydraulic press	no	
25.	variable amplitude service loading	no	
26.	Automatic reciprocating system,	no	
27.	variable amplitude service loading	no	
28.	variable amplitude service loading	no	
UNIT – IV **UNIT IVELASTIC PLASTIC FRACTURE MECHANICS**			
29.		no	
30.	Relative merits and demerits over hydraulic	no	

	Systems		
31.	Pneumatic conditioners	no	(T2) Chapter 12
32.	Filters, Regulators,	no	(T2) Chapter 11
33.	Lubricators,Mufflers	no	
34.	Air dryers. Pneumatic actuators,	no	
35.	pneumatic circuits, Hydro Pneumatics-	no	
36.	Pneumatic logic controls	no	
37.	Electro hydraulic systems – Servo Systems	no	
UNIT – V **APPLICATIONS OF FRACTURE MECHANICS 9**			
38.	Fracture design	no	(T2) Chapter 15 (T2) Chapter 14
39.	selection of materials	no	
40.	Fatigue crack growth rate curve	no	
41.	PLC applications in fluid power control.	no	
42.	stress intensity factor range	no	
43.	stress intensity factor range	no	
44.	Use of crack growth law	no	
45.	Use of crack growth law	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.
- Practical 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 Mr.Arun V Rejus Kumar

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.

Course Teacher	Signature
Mr.Arun V Rejus Kumar Mr.Thirumavalavan	

Course Coordinator
Mr.Arun V Rejus
Kumar

HOD/MECH