Academic Course Description
BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Mechanical Engineering
BGE007 – GAS DYNAMICS AND SPACE PROPULSION
Seventh Semester, 2015-16 (odd Semester)

Course (catalog) description

- To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.
- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow.
- To gain some basic knowledge about jet propulsion and Rocket Propulsion.

Compulsory/Elective course : Elective

Credit & contact hours : 3 & 45

Course Coordinator : Mr.Thirumavalavan

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
R.Sabarish	VII SEM MECH A	JR101		R.Sabarishr.mech@ bharathuniv.ac.in	9.00 - 9.50 AM
Mr.Thirumavalavan	VII SEM MECH B	JR102		Thirumavalavan.mech@ bharathuniv.ac.in	10.50 - 11.40 AM

Relationship to other courses:

Pre –requisites **:** Heat and Mass Transfer

Assumed knowledge : To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion. To understand the basic difference between incompressible and compressible flow. To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.

Following courses : Nil

Syllabus Contents

UNIT I BASIC CONCEPTS OF COMPRESSIBLE FLOW 9

Compressible fluid flow-energy and momentum equations, stagnation stages, various regions of flow, reference velocities, effect of Mach number on compressibility. Types of waves, Mach cone, Mach angle.

UNIT II FLOW THROUGH DUCTS 9

Flow through variable area ducts-nozzles and diffusers, Mach number variation, stagnation and critical states, area ratio as a function of Mach number.

Flow through constant area ducts-with friction (Fanno flow), with heat transfer (Reyleigh flow), Variation of flow properties. Use of Gas Tables and Charts.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations, variation of flow parameters across the normal and oblique shocks. Prandtl Meyer relations. Flow in variable area ducts with normal shocks. Use of Tables and Charts.

UNIT IV JET PROPULSION 9

Types of jet engines-turboprop, turbojet, ramjet, pulsejet. Aircraft propulsion theory, performance analysis of jet engines, parameters affecting flight performance, thrust augmentation.

UNIT V ROCKET PROPULSION 9

Types of rocket engines, propellants, combustion instabilities, rocket propulsion theory, performance of rocket engine, multistage rockets, orbital and escape velocities.

TEXTBOOKS:

1. Yahya S.M. Fundamentals of Compressible Flow, New Age International (P) Ltd., New Delhi, 2003.
2. Ganesan V, Gas Turbines, Tata McGraw-Hill Publishing Company Ltd., 2003.

REFERENCES:

1. Philip G Hill and Carl R. Peterton, Mechanics and Thermodynamics of Propulsion, Addison-Wesley Publishing Company, 1999.
2. Khajuria P.R and Dubey S.P., Gas turbines and Propulsive Systems, Dhanpat RaiPublications (P) Ltd, New Delhi 2003.
3. Cohen H. Rogers GFC, Saravanamuttoo HIH, Gas Turbines Theory, Addison-Wesley Long man Ltd., 2001.
4. freecomputerbooks.com/**Total-Quality-Management**-and-Six-Sigma.htm.

Computer usage:

Professional component

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

Broad area: Space propulsion

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 1	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

Student Outcomes (SOs) from Criterion 3 covered by this Course	Correlates to program outcome		
	H	**M**	**L**
1. Will get knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.	a		
2. Will understand the basic difference between incompressible and compressible flow.		b	
3. Will understand the phenomenon of shock waves and its effect on flow.	c,e,i	d	
4. Will understand the jet propulsion		h,l	e
5. To learn about the rocket propulsion			g,j,k
6. To learn about the types of rocket engine			

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

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I BASIC CONCEPTS OF COMPRESSIBLE FLOW			
1	Compressible fluid flow	yes	T1 & R1
2	energy and momentum equations,	yes	
3	stagnation stages,	yes	

4	various regions of flow,	yes	
5	reference velocities,	yes	
6	effect of Mach number on compressibility.	yes	
7	Types of waves,	yes	
8	Mach cone,	yes	
9	Mach angle.	yes	
UNIT II FLOW THROUGH DUCTS			
10	Flow through variable area ducts	yes	
11	nozzles and diffusers,	yes	
12	Mach number variation,	yes	
13	stagnation and critical states,	yes	
14	area ratio as a function of Mach number.	yes	T1 & R3
15	Flow through constant area ducts-with friction (Fanno flow),	yes	
16	with heat transfer (Reyleigh flow),	yes	
17	Variation of flow properties.	yes	
18	Use of Gas Tables and Charts.	yes	
UNIT III NORMAL AND OBLIQUE SHOCKS			
19	Governing equations	yes	
20	variation of flow parameters across the normal and oblique shocks.	yes	
21	variation of flow parameters across the normal and oblique shocks.	yes	
22	Prandtl Meyer relations.	yes	T1 & R2
23	Prandtl Meyer relations.	yes	
24	Flow in variable area ducts with normal shocks.	yes	
25	Flow in variable area ducts with normal shocks.	yes	
26	Flow in variable area ducts with normal shocks.	yes	
27	Use of Tables and Charts.	yes	
UNIT IV JET PROPULSION			
28	Types of jet engines	yes	
29	turboprop,	yes	
30	turbojet,	yes	
31	ramjet,	yes	
32	pulsejet.	yes	T2 & R4
33	Aircraft propulsion theory,	yes	
34	performance analysis of jet engines,	yes	
35	parameters affecting flight performance	yes	
36	thrust augmentation.	yes	
UNIT V ROCKET PROPULSION			
37	Types of rocket engines,	yes	
38	propellants,	yes	
39	propellants,	yes	
40	combustion instabilities,	yes	T1 & R3
41	combustion instabilities,	yes	
42	rocket propulsion theory,	yes	
43	performance of rocket engine,	yes	

44	multistage rockets,	yes	
45	orbital and escape velocities.	yes	

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 **R.Sabarish** **Dated:** 07.08.2017

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
R.Sabarish Mr.Thirumavalavan	

Course Coordinator **HOD/MECH**
R.Sabarish