LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
L.B.Reddy Nagar, Mylavaram – 521 230.Andhra Pradesh, INDIA
Affiliated to JNTUK, Kakinada & Approved by AICTE New Delhi
Accredited by NAAC, An ISO 9001:2015 Certified Institution
DEPARTMENT OF AEROSPACE ENGINEERING
Website: http://lbrce.ac.in Email: hodaero@lbrce.ac.in

COURSE HANDOUT
PART-A

Name of Course Instructor	: Mr. G V SURYA NARAYANA		
Course Name & Code	: **CAD/CAM- 17ME22**		
L-T-P Structure	: 3-0-0	Credits	: 3
Program/Sem/Sec	: B.Tech., V-Sem.	A.Y	: 2021-22

Prerequisite Subject:

Machine Drawing, Machine Design, Machine Tools

COURSE EDUCATIONAL OBJECTIVES:

The main objective of this course is to familiarize the principles of geometric modelling, numerical control and part programming.

COURSE OUTCOMES:

After completion of the course students are able to:

CO1:	Comprehend the principles of CAD/CAM for design and manufacturing (Underastand-L2)
CO2:	Formulate mathematical equations for geometrical entities like curves, surface, and solids (Apply-L3)
CO3:	Program for part profiles to accomplish numerical control machining (Apply-L3)
CO4:	Develop a pseudo codes for different parts using GT codes and apply in automated manufacturing systems (Apply-L3)
CO5:	Become cognizant about CAQC techniques that are to be applied in manufacturing industry and able to comprehend the applications of Computer Integrated Manufacturing (Underastand-L2)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	1	1	3
CO2	3	3	3	2	2	-	-	-	-	-	-	1	1	3
CO3	3	3	3	2	3	-	-	-	-	-	-	1	1	3
CO4	3	3	3	3	3	-	-	-	-	-	-	1	1	3
CO5	3	3	3	3	3	-	-	-	-	-	-	1	1	3

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS

1. Mikel P.Groover and Emory W.Zimmers, CAD/CAM-prentice Hall of India private Ltd.New Delhi, 20th edition, May 2010.
2. Ibrahim Zeid, Mastering CAD/CAM, TATA McGraw-Hill publishing CO.Ltd, New Delhi2011.

REFERENCES

1. P.N Rao,CAD/CAM Principle and applications, Tata McGraw Hill Education Private Ltd,New Delhi,8th edition 2013.
2. P.Radhakrishnan,S.Subramanyam&V.Raju,CAD/CAM/CIM,New Age International Publishers,3rd edition 2010.
3. MikelP.Groover, Automaiton, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India private Ltd.New Delhi, 3rd edition, May 2008.
4. Ibrahim Zeid and R. Sivasubramanian, CAD/CAM theory and practice, Tata McGraw Hill publishing Co. Ltd, New Delhi 2009.
5. Tien-Chienchang, Richard A.Wysk and HSU-Pin (Ben) Wang, "Computer Aided Manufacturing", 3rd Edition, 2006

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: FUNDAMENTALS OF CAD

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to fundamentals of cad	1	20-09-2021		**TLM1, TLM2**	
2.	The design process, The application of Computers for design	1	22-09-2021		**TLM1, TLM2**	
3.	Benefits of CAD	1	24-09-2021		**TLM1, TLM2**	
4.	Introduction to computer graphics	1	27-09-2021		**TLM1, TLM2**	
5.	Raster scan graphics, Transformation of geometry	1	29-09-2021		**TLM1, TLM2**	
6.	Translation, scaling,	1	01-10-2021		**TLM1, TLM2**	
7.	reflection, Rotation	1	04-10-2021		**TLM1, TLM2**	
8.	homogeneous transformations	1	06-10-2021		**TLM1, TLM2**	
9.	Concatenated transformations, Assignment-I	1	08-10-2021		**TLM1, TLM2**	
No. of classes required to complete UNIT-I: 09				No. of classes taken:		

UNIT-II: GEOMETRIC MODELING: **REPRESENTATION OF CURVES**

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
10.	Introduction, wireframe models, wireframe entities,	1	11-10-2021		**TLM1, TLM2**	

11.	curve representation,	1	18-10-2021		**TLM1, TLM2**	
12.	parametric representation of analytical curves,	1	22-10-2021		**TLM1, TLM2**	
13.	Parametric representation of Bezier and B-Spline curves.	1	25-10-2021		**TLM1, TLM2**	
14.	**REPRESENTATION OF SURFACES AND SOLIDS**: Introduction to surfaces,	1	27-10-2021		**TLM1, TLM2**	
15.	surface models surface entities. Introduction to solids,	1	29-10-2021		**TLM1, TLM2**	
16.	solid models, solid entities,	1	01-11-2021		**TLM1, TLM2**	
17.	Fundamentals of solid modeling, Boundary representation,	1	03-11-2021		**TLM1, TLM2**	
18.	CSG representation, Sweep representation.	1	05-11-2021		**TLM1, TLM2**	
No. of classes required to complete UNIT-II:09				No. of classes taken:		

UNIT-III: COMPUTER NUMERICAL CONTROL

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
19.	Introduction, NC modes, NC elements, NC Coordinate systems	1	15-11-2021		**TLM1, TLM2**	
20.	Structure of CNC Machine Tools	1	17-11-2021		**TLM1, TLM2**	
21.	Spindle design	1	19-11-2021		**TLM1, TLM2**	
22.	Spindle drives	1	22-11-2021		**TLM1, TLM2**	
23.	Feed drives	1	24-11-2021		**TLM1, TLM2**	
24.	Actuation systems.	1	26-11-2021		**TLM1, TLM2**	
25.	**PART PROGRAMMING**: Part programming Fundamentals	1	29-11-2021		**TLM1, TLM2**	
26.	Manual part programming	1	01-12-2021		**TLM1, TLM2**	
27.	computer aided part programming	1	03-12-2021		**TLM1, TLM2**	

28.	APT Language	1	06-12-2021		**TLM1, TLM2**	
No. of classes required to complete UNIT-III:10				No. of classes taken:		

UNIT-IV : GROUP TECHNOLOGY

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
29.	**GROUP TECHNOLOGY**: Introduction, Part families, Part classifications and coding	1	08-12-2021		**TLM1, TLM2**	
30.	OPITZ-system,	1	10-12-2021		**TLM1, TLM2**	
31.	MICLASS system	1	13-12-2021		**TLM1, TLM2**	
32.	CODE system – GT Machine cells	1	15-12-2021		**TLM1, TLM2**	
33.	Benefits of GT	1	17-12-2021		**TLM1, TLM2**	
34.	CAPP: Retrieval type and generative type	1	20-12-2021		**TLM1, TLM2**	
35.	**FLEXIBLE MANUFACTURING SYSTEM**: Introduction	1	22-12-2021		**TLM1, TLM2**	
36.	FMS components	1	24-12-2021		**TLM1, TLM2**	
37.	Benefits of FMS	1	27-12-2021		**TLM1, TLM2**	
No. of classes required to complete UNIT-IV:09				No. of classes taken:		

UNIT-V : COMPUTER AIDED QUALITY CONTROL

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
38.	Computer Aided Quality Control: Introduction – computers in QC	1	29-12-2021		**TLM1, TLM2,**	
39.	Contact Inspection methods – optical, non-optical	1	31-12-2021		**TLM1, TLM2,**	
40.	Non-contact inspection methods: optical, non-optical	1	03-01-2022		**TLM1, TLM2,**	
41.	Computer Aided Testing-	1	05-01-2022		**TLM1,**	
42.	Integration of CAQC with CAD/CAM.	1	07-01-2022		**TLM1, TLM2,**	
43.	Computer Integrated Manufacturing Systems	1	10-01-2022		**TLM1,**	

44.	Introduction–Integration of CIM	1	12-01-2022		**TLM1, TLM2,**	
45.	Benefits of CIM and Lean manufacturing	1	14-01-2022		**TLM1, TLM2,**	
No. of classes required to complete UNIT-V:08				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R17 Regulations):

Evaluation Task	**Marks**
Assignment-I (Unit-I)	A1=5
Assignment-II (Unit-II)	A2=5
I-Mid Examination (Units-I & II)	M1=20
I-Quiz Examination (Units-I & II)	Q1=10
Assignment-III (Unit-III)	A3=5
Assignment-IV (Unit-IV)	A4=5
Assignment-V (Unit-V)	A5=5
II-Mid Examination (Units-III, IV & V)	M2=20
II-Quiz Examination (Units-III, IV & V)	Q2=10
Attendance	B=5
Assignment Marks = Best Four Average of A1, A2, A3, A4, A5	A=5
Mid Marks =75% of Max(M1,M2)+25% of Min(M1,M2)	M=20
Quiz Marks =75% of Max(Q1,Q2)+25% of Min(Q1,Q2)	B=10
Cumulative Internal Examination (CIE) : A+B+M+Q	40
Semester End Examination (SEE)	60
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures, and Flight Dynamics in Aerospace vehicle design.
PSO2	To prepare the students to work effectively in Aerospace and Allied Engineering organizations.

Course Instructor	Module Coordinator	HOD
Mr. G V Surya Narayana	Mr. I. Dakshina Murthy	Dr. P. Lovaraju

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COURSE HANDOUT

PROGRAM : B.Tech., V-Sem., ASE

ACADEMIC YEAR : 2021-22

COURSE NAME & CODE : AERODYNAMICS-II (17AE10)

L-T-P STRUCTURE : 2-2-0

COURSE CREDITS : 3

COURSE INSTRUCTOR : Mr. I Dakshina Murthy

COURSE COORDINATOR : Dr. P. Lovaraju

PRE-REQUISITE: Engineering Fluid Mechanics, Engineering Thermodynamics, Aerodynamics-I

Course Educational Objectives:
To learn the basic concepts of compressible fluid flows, steady one-dimensional flow properties discharging from a reservoir, the supersonic flow properties, the basic formulation for flow with friction and heat transfer and the theoretical aspects of compressible flow over wings

Course Outcomes: At the end of the semester, the student will be able to
CO1: Apply the of compressible fluid flow equations to solve flow problems (Apply-L3)
CO2: Apply the steady one-dimensional flow principles in designing the nozzles and diffusers (Apply-L3)
CO3: Characterize the supersonic flow behaviour over objects (Apply-L3)
CO4: Characterize the flow through ducts by considering friction and heat transfer affects (Apply-L3)
CO5: Apply compressible flow theory to analyze flow over wings (Apply-L3)

COURSE ARTICULATION MATRIX (Correlation between CO, PO & PSO):

Course Code	COs	Program Outcomes												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
17AE10	CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	3
	CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	3
	CO3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
	CO4	3	2	2	3	-	-	-	-	-	-	-	3	3	3
	CO5	3	2	2	3	-	-	-	-	-	-	-	3	3	3
1 = Slight (Low)				2 = Moderate (Medium)								3-Substantial(High)			

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-' 1-** Slight(Low), **2 -** Moderate(Medium), **3 -** Substantial (High).

BOS APPROVED TEXT BOOKS:

T1 Rathakrishnan. E, Gas Dynamics, Sixth Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2017

BOS APPROVED REFERENCE BOOKS:

R1 Ascher H. Shapiro, The dynamics and thermodynamics of compressible fluid flow Vol 1, The Ronald press Co. New York, 1953

R2 Lipmann. H. W, Roshko. A, Elements of Gas Dynamics, John Wiley & Sons, New York

R3 Thomson P.A., Compressible Fluid Dynamics, McGraw-Hill, New York, 1972

R4 Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: Basics of Compressible Flow

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
1.	Overview of the Course, Course outcome, Introduction	2	20/9/2021 21/9/2021		TLM2	CO1	T1	
2.	Revision of Thermodynamics related to this course	2	24/9/2021 25/9/2021		TLM2	CO1	T1	
3.	Compressibility and its limiting conditions	1	27/9/2021		TLM2	CO1	T1	
4.	Speed of Sound and its thermodynamics formulation	1	28/9/2021		TLM2	CO1	T1	
5.	Introduction to Entropy, Entropy formulations	1	01/10/2021		TLM2	CO1	T1	
6.	Basic form of Isentropic relations	1	04/10/2021		TLM2	CO1	T1	
7.	Isentropic relations suitable for Compressible flows (in terms of Mach number), Stagnation Properties	1	05/10/2021		TLM2	CO1	T1	
8.	Mach Angle, Mach cone, Mach wave, Shock Wave	1	08/10/2021		TLM2	CO1	T1	
9.	Wave Propagation	1	11/10/2021		TLM2	CO1	T1	
10.	Tutorial-I	1	12/10/2021		TLM3	CO1	T1	
11.	Assignment/Quiz-1	1	16/10/2021			CO1	T1	
No. of classes required to complete UNIT-I		13			No. of classes taken:			

UNIT-II: Steady One Dimensional Flow

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
12.	Introduction, Fundamental Equations	1	18/10/2021		TLM2	CO2	T1	
13.	Discharge from a reservoir formulations	1	19/10/2021		TLM2	CO2	T1	
14.	Mass flow per Unit Area	1	22/10/2021		TLM2	CO2	T1	
15.	Critical Values	1	23/10/2021		TLM2	CO2	T1	
16.	Streamtube Area velocity relation	1	25/10/2021		TLM2	CO2	T1	
17.	Nozzle and its types, Applications of Nozzle, De Laval Nozzle, Area Mach number relation	1	26/10/2021 29/10/2021		TLM2	CO2	T1	
18.	Isentropic flow through nozzle, Nozzle flow physics	2	30/10/2021 01/11/2021		TLM2	CO2	T1	
19.	Diffusers, Compressibility correction to dynamic pressure	1	02/11/2021		TLM2	CO2	T1	
20.	Tutorial-2	1	05/11/2021		TLM3	CO2	T1	
21.	Assignment/Quiz-2	1	06/11/2021		--	CO2	T1	
No. of classes required to complete UNIT-II		12		No. of classes taken:				

I Mid Examination (08/11/2021 to 13/11/2021)

UNIT-III: Shock and Expansion Waves

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
22.	Introduction and Types of Waves	1	15/11/2021		TLM2	CO3	T1	
23.	Normal Shock-Equations of Motion, Normal Shock relation for perfect gas	2	16/11/2021 19/11/2021,		TLM2	CO3	T1	
24.	Hugoniot Equation	1	20/11/2021		TLM2	CO3	T1	
25.	Oblique Shock introduction, Oblique Shock relations	2	22/11/2021 23/11/2021		TLM2	CO3	T1	
26.	Relation Between β-θ-M	2	26/11/2021, 27/11/2021		TLM2	CO3	T1	
27.	Detached shocks, Expansion waves, Prandtl Meyer Flow	1	29/11/2021		TLM2	CO3	T1	
28.	Flow with shocks and expansion waves at the exit of a convergent- divergent nozzle	1	30/11/2021		TLM2	CO3	T1	
29.	Tutorial-3	1	03/12/2021		TLM3	CO3	T1	
30.	Assignment/Quiz-3	1	04/12/2021			CO3		
No. of classes required to complete UNIT-III		12		No. of classes taken:				

UNIT-IV: Flow with Friction and Heat Transfer

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
31.	Introduction, Flow in constant Area Duct with friction	1	06/12/2021		TLM2	CO4	T1	
32.	Adiabatic Constant area flow of a perfect gas (basic Formulation)	2	07/12/2021 10/12/2021		TLM2	CO4	T1	
33.	Definition of Friction Coefficient, Effect of Wall Friction on Fluid Properties	1	13/12/2021		TLM2	CO4	T1	
34.	Working Relations	1	14/12/2021		TLM2	CO4	T1	

35.	Flow with heating and cooling in ducts, Rayleigh line relation	1	17/12/2021		TLM2	CO4	T1	
36.	Basic Formulation	1	18/12/2021		TLM2	CO4	T1	
37.	Working Relations	1	20/12/2021		TLM2	CO4	T1	
38.	Tutorial-4	1	21/12/2021		TLM3	CO4		
39.	Assignment/Quiz-4	1	24/12/2021			CO4		
No. of classes required to complete UNIT-IV		11		No. of classes taken:				

UNIT-V: Compressible Flow over Wings

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
40.	Introduction, Potential Equation for Compressible flow	2	27/12/2021 28/12/2021		TLM2	CO5	R4	
41.	Linearization of Potential Equation	1	31/12/2021		TLM2	CO5	R4	
42.	Prandtl-Glauert Rule	1	01/01/2022		TLM2	CO5	R4	
43.	Critical Mach Number	1	03/01/2022		TLM1	CO5	R4	
44.	Drag-Divergence Mach Number	1	04/01/2022		TLM1	CO5	R4	
45.	Area-Rule, Supercritical Aerofoil, Forward Swept and Swept Back Wings, Delta Wings	2	07/01/2022 08/01/2022		TLM1	CO5	R4	
46.	Crocco's Theorem	1	10/01/2022		TLM1	CO5	R4	
47.	Tutorial -5	1	11/01/2022		TLM3	CO5	R4	
48.	Assignment/Quiz-5	1	14/01/2022					
49.	Revision	1	15/01/2022		TLM2			
No. of classes required to complete UNIT-V		12		No. of classes taken:				

Contents beyond the Syllabus

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	Learning Outcome COs	Text Book followed	HOD Sign Weekly
50.	Hypersonics	1			TLM5		T1	

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (lab or field visit)
TLM2	PPT	**TLM5**	ICT (NPTEL, Swayam Prabha, MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/project

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	20-09-2021	06-11-2021	7W
I Mid Examinations	08-11-2021	13-11-2021	1W
II Phase of Instructions	15-11-2021	15-01-2022	9W
II Mid Examinations	17-01-2022	22-01-2022	1W
Preparation and Practical	24-01-2022	29-01-2021	1W
Semester End Examinations	31-01-2022	12-02-2022	2W

EVALUATION PROCESS:

Evaluation Task	COs	Marks
Assignment/Quiz – 1	1	A1=5
Assignment/Quiz – 2	2	A2=5
I-Mid Examination	1,2	B1=20
I-Mid Examination(Objective)	1,2	C1=10
Assignment/Quiz – 3	3	A3=5
Assignment/Quiz – 4	4	A4=5
Assignment/Quiz – 5	5	A5=5

II-Mid Examination	3,4,5	B2=20
II-Mid Examination(Objective)	3,4,5	C2=10
Evaluation of Assignment/Quiz Marks: A=(A1+A2+A3+A4+A5)/5	1,2,3,4,5	A=5
Evaluation of Mid Marks: B=75% of Max(B1,B2)+25% of Min(B1,B2)	1,2,3,4,5	B=20
Evaluation of Quiz Marks: C=75% of Max(C1,C2)+25% of Min(C1,C2)	1,2,3,4,5	C=10
Attendance Marks: D(>95%=5, 90-95%=4,85-90%=3,80-85%=2,75-80%=1)		D=5
Cumulative Internal Examination : A+B+C+D	**1,2,3,4,5**	**40**
Semester End Examinations	**1,2,3,4,5**	**E=60**
Total Marks: A+B+C+D+E	**1,2,3,4,5**	**100**

Program Educational Objectives (PEO)

PEOs	Statement
PEO1	To provide students with sound mathematical, engineering and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems
PEO2	To prepare students to excel in higher education programs and to succeed in industry/academia profession.
PEO3	To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career

PROGRAM OUTCOMES (POs)

PO1: To apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: To identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: To design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: To use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: To create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of limitations.

PO6: To apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO7: To understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO8: To apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO9: To function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: To communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: To demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: To recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design

PSO2: To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Course Instructor	**Module Coordinator**	**HOD**
Mr.I.Dakshina Murthy	**Dr.P.Lovaraju**	**Dr.P.Lovaraju**

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DEPARTMENT OF AEROSPACE ENGINEERING

COURSE HANDOUT

PART-A

Name of Course Instructor : Nazumuddin Shaik
Course Name & Code : **Propulsion– I- 17AE11**
L-T-P Structure : 3-0-0 Credits : 3
Program/Sem/Sec : B.Tech., V-Sem. A.Y: 2021-22

PRE-REQUISITE: Engineering Thermodynamics, Elements of Aerospace Engineering

COURSE EDUCATIONAL OBJECTIVES (CEOs): To learn engineering concepts of jet engines, flow through subsonic and supersonic inlets of a jet engine, principle of operation of aircraft jet engines, fundamentals of combustion process.

COURSE OUTCOMES (COs): At the end of the course, students are able to

CO 1	Comprehend the performance characteristics of various jet engines. (Underastand-L2)
CO 2	Understand effect of subsonic and supersonic inlets for jet engines. (Underastand-L2)
CO 3	Make use of velocity triangles and elementary theory of compressors to solve aircraft compressor problems. (Apply-L3)
CO 4	Identify the parameters governing the design of combustion chambers. (Underastand-L2)
CO 5	Estimate the performance of aircraft jet engine turbines. (Apply-L3)

COURSE ARTICULATION MATRIX (Correlation between COs, POs & PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	-	-	-	3	3	3

Note: Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**
1- Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

TEXT BOOKS:

T1 Ganesan. V, Gas Turbines, Third Edition, Tata McGraw-Hill, New Delhi, 2018
T2 Saravanamuttoo. H.I.H, Rogers. G. F. C, Cohen. H, Straznicky. P. V, Nix. A. C, Gas Turbine Theory, Seventh Edition Pearson Education, 2018.

REFERENCE BOOKS:

R1 Hill, P.G., Peterson, C.R. Mechanics & Thermodynamics of Propulsion, Addison – Wesley. Longman INC, 1999.
R2 Mattingly. J. D, Elements of propulsion: Gas Turbines and Rockets, AIAA Educational Series
R3 Rolls Royce Jet Engine, Third Edition, 1983.

PART-B

COURSE DELIVERY PLAN (LESSON PLAN):

UNIT-I: FUNDAMENTALS OF GAS TURBINE ENGINE

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Course and COs and Unit-I	1	22-09-2021		**TLM1&2**	
2.	Working of Gas Turbine Engine	1	23-09-2021		**TLM1&2**	
3.	**Characteristics of Turboprop**	1	25-09-2021		**TLM1&2**	
4.	Turbofan, And Turbojet Cycle Analysis	1	29-09-2021		**TLM1&2**	
5.	Performance Characteristics	1	30-09-2021		**TLM1&2**	
6.	**Thrust Equation - Factors Affecting Thrust**	1	06-10-2021		**TLM1&2**	
7.	Methods of Thrust Augmentation	1	07-10-2021		**TLM1&2**	
8.	Problems	1	09-10-2021		**TLM1&2**	
No. of classes required to complete UNIT-I: 08				No. of classes taken:		

UNIT-II: SUBSONIC AND SUPERSONIC INLETS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-II	1	20-10-2021		**TLM1&2**	
2.	Subsonic Inlets	1	21-10-2021		**TLM1&2**	
3.	**Internal Flows and External Flow**	1	23-10-2021		**TLM1&2**	
4.	Supersonic Inlets	1	27-10-2021		**TLM1&2**	
5.	Starting Problem On Supersonic Inlets	1	28-10-2021		**TLM1&2**	
6.	**Shock-Swallowing**	1	30-10-2021		**TLM1&2**	
7.	Flow Stability Problem	1	03-11-2021		**TLM1&2**	
8.	Problems	1	06-11-2021		**TLM1&2**	
No. of classes required to complete UNIT-II:08				No. of classes taken:		

UNIT-III: COMPRESSORS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-III	1	17-11-2021		**TLM1&2**	
2.	Principle of Operation of Centrifugal Compressor	1	18-11-2021		**TLM1&2**	
3.	**Work Done and Pressure Rise – Velocity Diagrams**	1	20-11-2021		**TLM1&2**	
4.	Diffuser Vane Design Considerations	1	24-11-2021		**TLM1&2**	
5.	Concept of Prewhirl, Stall and Surge	1	25-11-2021		**TLM1&2**	

6.	**Elementary Theory of Axial Flow Compressor**	1	27-11-2021		**TLM1&2**	
7.	Velocity Triangles – Degree of Reaction, Compressor Blade Design	1	01-12-2021		**TLM1&2**	
8.	Centrifugal Compressor Performance Characteristics	1	02-12-2021		**TLM1&2**	
9.	Axial Compressor Performance Characteristics and Problems	1	04-12-2021		**TLM1&2**	
No. of classes required to complete UNIT-III:09				No. of classes taken:		

UNIT-IV : COMBUSTION CHAMBERS

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-IV and Classification of Combustion Chambers	1	08-12-2021		**TLM1&2**	
2.	**Combustion Process**	1	09-12-2021		**TLM1&2**	
3.	**Important Factors Affecting Combustion Chamber Design**	1	11-12-2021		**TLM1&2**	
4.	Combustion Chamber Performance	1	15-12-2021		**TLM1&2**	
5.	Effect of Operating Variables on Performance	1	16-12-2021		**TLM1&2**	
6.	**Flame Tube Cooling**	1	18-12-2021		**TLM1&2**	
7.	Flame Stabilization, Use of Flame Holders	1	22-12-2021		**TLM1&2**	
8.	Fuel Injection System and Problems	1	23-12-2021		**TLM1&2**	
No. of classes required to complete UNIT-IV:08				No. of classes taken:		

UNIT-V : TURBINES

S.No.	Topics to be covered	No. of Classes Required	Tentative Date of Completion	Actual Date of Completion	Teaching Learning Methods	HOD Sign Weekly
1.	Introduction to Unit-V and Elementary Theory of Turbines	1	29-12-2021		**TLM1&2**	
2.	**Impulse and Reaction Turbines**	1	30-12-2021		**TLM1&2**	
3.	Axial Flow Turbine, Radial Flow Turbine	1	05-01-2022		**TLM1&2**	
4.	Velocity Triangles and Power Output	1	06-01-2022		**TLM1&2**	
5.	**Estimation of Stage Performance**	1	08-01-2022		**TLM1&2**	
6.	Turbine Performance Characteristics	1	12-01-2022		**TLM1&2**	
7.	Methods of Blade Cooling	1	13-01-2022		**TLM1&2**	
8.	Matching of Turbine and Compressor and Problems	1	15-01-2022		**TLM1&2**	
No. of classes required to complete UNIT-V:08				No. of classes taken:		

Teaching Learning Methods			
TLM1	Chalk and Talk	**TLM4**	Demonstration (Lab/Field Visit)
TLM2	PPT	**TLM5**	ICT (NPTEL/Swayam Prabha/MOOCS)
TLM3	Tutorial	**TLM6**	Group Discussion/Project

PART-C

EVALUATION PROCESS (R17 Regulations):

Evaluation Task	Marks
Assignment-I (Unit-I)	A1=5
Assignment-II (Unit-II)	A2=5
I-Mid Examination (Units-I & II)	M1=20
I-Quiz Examination (Units-I & II)	Q1=10
Assignment-III (Unit-III)	A3=5
Assignment-IV (Unit-IV)	A4=5
Assignment-V (Unit-V)	A5=5
II-Mid Examination (Units-III, IV & V)	M2=20
II-Quiz Examination (Units-III, IV & V)	Q2=10
Attendance	B=5
Assignment Marks = Best Four Average of A1, A2, A3, A4, A5	A=5
Mid Marks =75% of Max(M1,M2)+25% of Min(M1,M2)	M=20
Quiz Marks =75% of Max(Q1,Q2)+25% of Min(Q1,Q2)	B=10
Cumulative Internal Examination (CIE) : A+B+M+Q	40
Semester End Examination (SEE)	60
Total Marks = CIE + SEE	100

PART-D

PROGRAMME OUTCOMES (POs):

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8	**Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO 1	To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO 2	To prepare the students to work effectively in Aerospace and Allied Engineering organizations

Course Instructor	Module Coordinator	HOD
Mr. Nazumuddin Shaik	Dr. P. Lovaraju	Dr.P. Lovaraju

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Department of Aerospace Engineering
Website: http://lbrce.ac.in Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:513/515

COURSE HANDOUT
PART - A

PROGRAM : B.Tech., V-Sem., AE
ACADEMIC YEAR : 2021-22
COURSE NAME & CODE : Aerodynamics Laboratory – 17AE63
L-T-P STRUCTURE : 0-0-2
COURSE CREDITS : 1
COURSE INSTRUCTOR(S) : Dr.P.Lovaraju/Mr.I Dakshina Murthy/Mr.D.Rakesh

Course Educational Objectives:

1. To learn basic experiments in wind tunnel
2. To learn basic experiments in open jet facility
3. To learn basic visualization techniques

Course Outcomes:

After completion of the course students will able to:

CO1	To analyze the flow characteristic over bodies
CO2	To design nozzle and to analyze the flow characteristics.

COURSE ARTICULATION MATRIX (Correlation between COs&POs,PSOs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2		3	3				1		2	3	3	3
CO2	3	2	2	3	2				1		2	3	3	3

Note: Enter Correlation Levels 1 or 2 or 3. If there is no correlation, put '-'
1- Slight (Low), 2 – Moderate (Medium), 3 - Substantial (High).

PART - B
Detailed Schedule of Experiments

Exp. No	Date	BATCH - A					BATCH - B					CO	HOD Review
		A1	A2	A3	A4	A5	B1	B2	B3	B4	B5		
CYCLE 1													
Exp. No 1	Scheduled Date	20/09/21	27/09/21	04/10/21	11/10/21	18/10/21	22/09/21	29/09/21	06/10/21	27/10/21	03/11/21	CO1	
	Actual Date												
Exp. No 2	Scheduled Date	18/10/21	20/09/21	27/09/21	04/10/21	11/10/21	03/11/21	22/09/21	29/09/21	06/10/21	27/10/21	CO1	
	Actual Date												
Exp. No 3	Scheduled Date	11/10/21	18/10/21	20/09/21	27/09/21	04/10/21	27/10/21	03/11/21	22/09/21	29/09/21	06/10/21	CO1	
	Actual Date												
Exp. No 4	Scheduled Date	04/10/21	11/10/21	18/10/21	20/09/21	27/09/21	06/10/21	27/10/21	03/11/21	22/09/21	29/09/21	CO1	
	Actual Date												
Exp. No 5	Scheduled Date	27/09/21	04/10/21	11/10/21	18/10/21	20/09/21	29/09/21	06/10/21	27/10/21	03/11/21	22/09/21	CO1	
	Actual Date												
CYCLE 2													
Exp. No 6	Scheduled Date	25/10/21	01/11/21	15/11/21	22/11/21	29/11/21	17/11/21	24/11/21	01/12/21	08/12/21	15/12/21	CO1	
	Actual Date												
Exp. No 7	Scheduled Date	29/11/21	25/10/21	01/11/21	15/11/21	22/11/21	15/12/21	17/11/21	24/11/21	01/12/21	08/12/21	CO2	
	Actual Date												
Exp. No 8	Scheduled Date	22/11/21	29/11/21	25/10/21	01/11/21	15/11/21	08/12/21	15/12/21	17/11/21	24/11/21	01/12/21	CO2	
	Actual Date												
Exp. No 9	Scheduled Date	15/11/21	22/11/21	29/11/21	25/10/21	01/11/21	01/12/21	08/12/21	15/12/21	17/11/21	24/11/21	CO2	
	Actual Date												
Exp. No 10	Scheduled Date	01/11/21	15/11/21	22/11/21	29/11/21	25/10/21	24/11/21	01/12/21	08/12/21	15/12/21	17/11/21	CO2	
	Actual Date												
Repetition & Viva-voce	Scheduled Date	06/12/21, 13/12/21, 20/12/21, 27/12/21 & 04/01/22					22/12/2021, 29/12/2021 & 06/01/2022						
	Actual Date												
Internal Exam	Scheduled Date: 11-01-2022 Actual Date :						Scheduled Date: 13-01-2022 Actual Date :						

BATCH:A	BATCH:B
A_1 ----19761A2101, 02, 03, 04, 05 & 06	B_1 ---- 19761A2131, 32, 33, 34, 35 & 36
A_2 -----19761A2108, 09, 10, 11, 13 & 14	B_2 ---- 19761A2137, 38, 39, 40, 41 & 42
A_3 -----19761A2115, 16, 17, 18, 19 & 20	B_3 ---- 19761A2143, 44, 45, 46 & 47
A_4 ----- 19761A2121, 22, 23, 24 & 25	B_4 ----19761A2148, 49, 20765A2101, 02 & 03
A_5 ----- 19761A2126, 27, 28, 29 & 30	B_5 – 20765A2104, 05, 06, 07 & 08

LIST OF EXPERIMENTS

CYCLE I

1. Determination of lift and drag for symmetrical aerofoil
2. Determination of lift and drag for unsymmetrical aerofoil

3. Pressure distribution over a smooth circular cylinder
4. Flow visualization study over objects in water flow channel
5. Generation of potential flow pattern over objects using Hele-Shaw Apparatus

CYCLE II

1. Pressure distribution over a symmetrical aerofoil
2. Pressure distribution over a cambered aerofoil
3. Design and calibration of convergent nozzle
4. Design and calibration of convergent-divergent nozzle
5. Shock pattern visualization using shadowgraph

ACADEMIC CALENDAR:

Description	From	To	Weeks
I Phase of Instructions-1	20-09-2021	06-11-2021	7W
I Mid Examinations	08-11-2021	13-11-2021	1W
II Phase of Instructions	15-11-2021	15-01-2022	9W
II Mid Examinations	17-01-2022	22-01-2022	1W
Preparation and Practical	24-01-2022	29-01-2021	1W
Semester End Examinations	31-01-2022	12-02-2022	2W

PART – C

EVALUATION PROCESS:

Parameter		Marks
Day – to – Day Work	Observation	A1 = 10 Marks
	Record	A2 = 10 Marks
Internal Test		B =10 Marks
Attendance		C = 05 Marks
Viva – Voce During Regular Lab Sessions		D = 05 Marks
Cumulative Internal Examination		**A1+ A2 + B+C+D = 40 Marks**
Semester End Examinations		**E = 60 Marks**
Total Marks: A1+ A2 + B + C + D + E		**100 Marks**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To Attain a solid foundation in Electronics & Communication Engineering fundamentals with an attitude to pursue continuing education.

PEO2: To Function professionally in the rapidly changing world with advances in technology.

PEO3: To Contribute to the needs of the society in solving technical problems using Electronics & Communication Engineering principles, tools and practices.

PEO4: To Exercise leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2:Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3:Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4:Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5:Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6:The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7:Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10:Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
PSO2: To prepare the students to work effectively in the defense and space research programs

Course Instructor	**Module Coordinator**	**HOD**
Mr. I Dakshina Murthy	**Mr. I Dakshina Murthy**	**Dr.P.Lovaraju**

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Department of Aerospace Engineering

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BRANCH: AEROSPACE **LAB: Aerodynamics (17AE63)**

COURSE: B.Tech (V Sem) **A.Y: 2021-22**

LABORATORY TIME TABLE

DAY	1 9.00 to 10.00	2 10.00 to 11.00	3 11.10 to 12.10	12.10 to 01.10	4 01.10 to 02.10	5 02.10 to 03.10	6 03.10 to 04.10
MON				LUNCH		---AD Lab (Batch A)---	
TUE							
WED						---AD Lab (Batch B)---	
THU							
FRI							
SAT							

BATCH:A	BATCH:B
A_1 ----19761A2101, 02, 03, 04, 05 & 06	B_1 ---- 19761A2131, 32, 33, 34, 35 & 36
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A_3 -----19761A2115, 16, 17, 18, 19 & 20	B_3 ---- 19761A2143, 44, 45, 46 & 47
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A_5 ----- 19761A2126, 27, 28, 29 & 30	B_5 – 20765A2104, 05, 06, 07 & 08

Faculty In charge (s) **Head of the Department**