

**Deenbandhu Chhotu Ram University of Science & Technology, Murthal (Sonapat) Scheme of
 Studies & Examinations under Choice Based Credit System
 Programme: B.Tech. in Aeronautical Engineering; Year – 3rd(Semester – V); Session: 2020-21**

| S. No. | Course Code | Course Title | Teaching Schedule | | | Marks of Class Work | Examination Marks | | Total | Credit | Duration of Exam |
|--------------|-------------|---|-------------------|----------|----------|---------------------|-------------------|------------|------------|-----------|------------------|
| | | | L | T | P | | Theory | Practical | | | |
| 1 | AER 301C | Aero Engine Design | 3 | 1 | 0 | 25 | 75 | - | 100 | 4 | 3 |
| 2 | AER 303C | Aircraft Structure Analysis & Design | 3 | 1 | 0 | 25 | 75 | - | 100 | 4 | 3 |
| 3 | AER 305C | Aircraft Stability & Control | 3 | 1 | 0 | 25 | 75 | - | 100 | 4 | 3 |
| 4 | AER 307C | Compressible & Finite Wing Aerodynamics | 3 | 0 | 0 | 25 | 75 | - | 100 | 3 | 3 |
| 5 | ME 307C | Theory of Machines (Common With Mech.) | 3 | 0 | 0 | 25 | 75 | - | 100 | 3 | 3 |
| 6 | AER 309C | Aircraft Structure Analysis & Design Lab | 0 | 0 | 2 | 25 | - | 75 | 100 | 1 | 3 |
| 7 | AER 311C | Compressible & Finite Wing Aerodynamics Lab | 0 | 0 | 2 | 25 | - | 75 | 100 | 1 | 3 |
| 8 | AER 313C | Professional Training (Level II) | 0 | 0 | 4 | 100 | - | - | 100 | 2 | |
| 9 | HUM 301 C | Essence of Indian Traditional Knowledge | 3 | 0 | 0 | 25 | 75 | - | 100 | 0 | 3 |
| Total | | | 18 | 3 | 8 | 300 | 450 | 150 | 900 | 22 | |

NOTES:

- In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 5 questions selecting at least one question from each unit.
- The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
- For students admitted in B.Tech. 1st Year (C-Scheme) in 2019 & onwards and all trailing students: Examinations and evaluations of students shall be conducted, covering the entire syllabus, as per guidelines “AICTE Examination Reforms”. Students shall be informed about these reforms.

Subject: AERO ENGINE DESIGN

Subject Code: AER 301C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 3 | 1 | - | 4 | 25 | 75 | 3 hours | 100 |

UNIT – I

Introduction to Gas Dynamics:

TOPIC NO 1 Basics, simple flows, nozzle flow and design,
 TOPIC NO 2 nozzle operating characteristics for isentropic flow,
 TOPIC NO 3 shock waves in nozzle flow, inlet design and sizing,
 TOPIC NO 4 exhaust nozzles, thrust reversing and thrust vectoring,
 TOPIC NO 5 nozzle coefficients, nozzle performance.

Centrifugal Compressor:

TOPIC NO 6 Principal of operation, Work done, Pressure rise,
 TOPIC NO 7 Diffuser and compressor characteristics, numerical problems.
 TOPIC NO 8 Design characteristics.

Axial Flow Compressor:

TOPIC NO 9 Euler's turbo machinery equations,
 TOPIC NO 10 axial flow compressor analysis,
 TOPIC NO 11 cascade theory, velocity diagrams,
 TOPIC NO 12 flow annulus area stage parameters,
 TOPIC NO 13 degree of reaction, axial flow compressor coefficients,
 TOPIC NO 14 stage pressure ratio, repeating stage-repeating row-mean line design,
 TOPIC NO 15 performance and design.

UNIT – III

Axial Flow Turbine:

TOPIC NO 16 Introduction to turbine analysis,
 TOPIC NO 17 velocity diagrams, mean radius stage calculations,
 TOPIC NO 18 stage parameters, loading and flow coefficients,
 TOPIC NO 19 degree of reaction, axial flow turbine stage analysis,
 TOPIC NO 20 performance and design.

UNIT – IV

Prediction of Performance of Gas Turbines:

TOPIC NO 21 Component characteristics,
 TOPIC NO 22 off design operation of single shaft gas turbine,
 TOPIC NO 23 free turbine and jet engine.
 TOPIC NO 24 Method of displacing equilibrium running line.

Combustion Systems:



TOPIC NO 25 Operational requirements,
TOPIC NO 26 types of combustion systems,
TOPIC NO 27 design aspects of combustion chamber,
TOPIC NO 28 combustion process,
TOPIC NO 29 combustion chamber performance, Practical problems.

TEXT BOOKS:

1. “Elements of Gas Turbine Propulsion”, J.D. Mattingly, Tata McGraw Hill.
2. “Gas Turbine Theory”, Cohen, Rogers and Sarvanmattoo, John Wiley

REFERENCE BOOKS:

1. “Mechanics and Thermodynamics of Propulsion”, P.G.Hill & Peterson, Addison Wesley
2. Aircraft Propulsion, Saeed Farokhi ,Wiley & Sons.



Subject: AIRCRAFT STRUCTURAL ANALYSIS AND DESIGN
Subject Code: AER 303C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 3 | 1 | - | 4 | 25 | 75 | 3 hours | 100 |

UNIT – I

Inelastic Buckling:

TOPIC NO 1 Flexural - torsional buckling of thin walled columns,
 TOPIC NO 2 buckling of thin plates, inelastic
 TOPIC NO 3 Buckling of plates,
 TOPIC NO 4 experimental determination of critical load,
 TOPIC NO 5 local instability, instability of stiffened panels,
 TOPIC NO 6 full tension and semi tension field beams

UNIT – II

Airframe Loads:

TOPIC NO 7 Aircraft inertia loads, symmetric maneuver loads,
 TOPIC NO 8 steady pull out, correctly banked turn,
 TOPIC NO 9 gust loads, gust envelope, numerical problems,
 TOPIC NO 10 fatigue, safe life and fail-safe structures,
 TOPIC NO 11 designing against fatigue, fatigue strength of components,
 TOPIC NO 12 prediction of aircraft fatigue life.

UNIT – III

Bending and Shear of Open and Closed Tubes:

TOPIC NO 13 Symmetrical bending,
 TOPIC NO 14 direct stress due to bending,
 TOPIC NO 15 deflection due to bending,
 TOPIC NO 16 approximation for thin walled section,
 TOPIC NO 17 shear of open section beams,
 TOPIC NO 18 shear centre, shear of closed section beams.

Structural Idealization:

TOPIC NO 19 Analysis of combined open and closed sections in shear and torsion,
 TOPIC NO 20 effect of idealization on bending,
 TOPIC NO 21 shear and torsion analysis of open and closed section beams,
 TOPIC NO 22 deflection of open and closed section beams.

UNIT – IV

Stress Analysis of Wing and Fuselage:

TOPIC NO 23 Tapered wing spar,
 TOPIC NO 24 open and closed sections,
 TOPIC NO 25 beams with variable stringer areas,
 TOPIC NO 26 bending, shear and torsion analysis of fuselage

Stress Analysis of Aircraft Components:

TOPIC NO 27 Analysis of wing in bending,
 TOPIC NO 28 shear and torsion,
 TOPIC NO 29 stress analysis of tapered wings,



TOPIC NO 30 cut – outs in wings, stiffened webs,
TOPIC NO 31 fuselage frame,
TOPIC NO 32 wing ribs.

TEXT BOOKS:

1. “Aircraft Structures for Engineering Students”: T.H.G.Megson ,4th Ed. Elsevier Ltd.
2. “Structural stability of Columns and Plates”, N G R Iyengar, John Wiley & sons

REFERENCE BOOKS:

- 1“Introduction to Structural Stability” : C.Chajis Prentice Hall Inc. Engle Wood Cliff
- 2“Aircraft structures” : D.J.PEERY, McGraw Hill.



Subject: AIRCRAFT STABILITY AND CONTROL

Subject Code: AER 305C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 3 | 1 | - | 4 | 25 | 75 | 3 hours | 100 |

UNIT – I

Stick Fixed Static Longitudinal Stability:

- TOPIC NO 1 Introduction to stability,
- TOPIC NO 2 Criterion for static stability of an aircraft,
- TOPIC NO 3 Contribution of different parts to stick fixed static longitudinal stability of aircraft,
- TOPIC NO 4 Effect of power, Neutral point (stick fixed), Centre of gravity limits.
- TOPIC NO 5 Static margin, In flight measurement of stick fixed neutral points.

UNIT – II

Stick Free Static Longitudinal Stability:

- TOPIC NO 6 Contribution of different parts to stick free static longitudinal stability of aircraft,
- TOPIC NO 7 Control surface hinge moments,
- TOPIC NO 8 Floating and restoring tendencies,
- TOPIC NO 9 Different types of tabs used on airplanes,
- TOPIC NO 10 Effect of free elevator on airplane stability,
- TOPIC NO 11 Elevator control power, Stick force gradients,
- TOPIC NO 12 Neutral point (stick free),
- TOPIC NO 13 Controls free center of gravity limit. In flight measurement of stick free neutral point

Maneuvering Flight:

- TOPIC NO 14 Effect of acceleration on airplane stability,
- TOPIC NO 15 Elevator angle per g,
- TOPIC NO 16 Stick force per g, Maneuver points and in flight measurement of maneuver points (stick fixed & stick free),
- TOPIC NO 17 Maneuver margins.

UNIT – III

Directional Stability and Controls:

- TOPIC NO 18 Asymmetric flight, Weather cock stability,
- TOPIC NO 19 Contribution of different parts of Aircraft,
- TOPIC NO 20 Adverse yaw, Frise Aileron, Spoiler Controls.
- TOPIC NO 21 Rudder Fixed and Rudder free static
- TOPIC NO 22 Directional stability,
- TOPIC NO 23 Rudder control power, Rudder lock.

Lateral Stability and Control:

- TOPIC NO 24 Dihedral Effect.
- TOPIC NO 25 Contribution of different parts of aircraft,
- TOPIC NO 26 Aileron control power,
- TOPIC NO 27 Cross coupling of lateral and directional effects.

UNIT – IV

Dynamic Stability:

TOPIC NO 28 Introduction to dynamics, Spring-Mass system.
TOPIC NO 29 Equations of motion,
TOPIC NO 30 Stability & control derivatives,
TOPIC NO 31 longitudinal dynamic stability,
TOPIC NO 32 Lateral and Directional dynamic stability,
TOPIC NO 33 Analysis of different stability modes

Parameter Estimation:

TOPIC NO 34 Parameter estimation,
TOPIC NO 35 various parameter estimation techniques,
TOPIC NO 36 Procedure for parameter estimation.

TEXT BOOKS:

1. “Flight Stability and Automatic Control”, R. C. Nelson, McGRAW-HILL
2. “Dynamics of Flight”, Bernard Etkin, John Wiley & Sons

REFERENCE BOOKS:

- 1 “Airplane Performance Stability and Control”, C. D. Perkins & R. E. Hage, John Wile



Subject: COMPRESSIBLE AND FINITE WING AERODYNAMICS
Subject Code: AER 307C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max.Marks | Exam Duration | |
| 3 | 1 | - | 4 | 25 | 75 | 3 hours | 100 |

UNIT – I

TOPIC NO 11 Elliptic and general lift distribution over finite unswept wings,
 TOPIC NO 12 effect of aspect ratio, Lifting Surface theory,
 TOPIC NO 13 Formation Flying, Ground effect.
 TOPIC NO 14 Drag reduction by variable twist, variable camber wings,
 TOPIC NO 15 Laminar flow control, winglets.

UNIT – III

Delta Wing Aerodynamics:

TOPIC NO 16 Polhamus theory, leading edge suction analogy,
 TOPIC NO 17 calculations of lift coefficient, flow field,
 TOPIC NO 18 aspect ratio effect, leading edge extension,
 TOPIC NO 19 HAA aerodynamics

Elements of Compressible Flow:

TOPIC NO 20 Compressible flow properties:
 TOPIC NO 21 Total Enthalpy, Total Temperature, Temperature and Pressure ratios as a function of Mach No.,
 TOPIC NO 22 Mass Flow Parameter (MFP).
 TOPIC NO 23 Isentropic Area ratio (A/A^*),
 TOPIC NO 24 Velocity-Area variations,
 TOPIC NO 25 Rayleigh Pitot tube formula,
 TOPIC NO 26 Flow in constant area duct with friction and heat transfer.

UNIT – IV

Experimental Methods:

TOPIC NO 27 Subsonic ,
 TOPIC NO 28 Transonic, supersonic wind tunnels,
 TOPIC NO 29 shock tube, wind tunnel balances,
 TOPIC NO 30 wind tunnel corrections,
 TOPIC NO 31 measurement of forces and moments,
 TOPIC NO 32 measurement of profile drag by pitot traverse of wake,
 TOPIC NO 33 shadowgraph system, Schlieren system,
 TOPIC NO 34 interferometer, Hot wire Anemometer

TEXT BOOKS:

1. “Aerodynamics”, L.J.Clancy, 5th Ed. Himalayan Books
2. “Aerodynamics for Engineers”, John J Bertin, 4th Ed, Pearson Publishers
3. “Modern Compressible Flow with Historical Perspective”, Anderson, J. D., 3rd ed., McGrawHill

REFERENCE BOOKS:

- 1 “Fundamentals of Aerodynamics”, John D.Anderson,5th Ed. McGraw Hill
- 2 “Aerodynamics for Engineering students”, E.L.Houghton and N.B.Carruthers,3rd Ed. Arnold Publishers

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Subject: THEORY OF MACHINES
Subject Code: ME307C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 3 | 1 | - | 4 | 25 | 75 | 3 hours | 100 |

UNIT I

Introduction

Topic No 1 Links-types,
 Topic No 2 Kinematics pairs-classification,
 Topic No 3 Constraints-types,
 Topic No4 Kinematic chains,
 Topic No5 Mechanism and machines,
 Topic No6 Degree of freedom, mobility-
 Topic No7 Grashof's law,
 Topic No8 Kinematic inversions of four bar chain and slider crank chains,
 Topic No9 Limit positions of four-bar mechanism,
 Topic No 10 Transmission angle in four bar mechanism and slider crank mechanism,
 Topic No 11 Synthesis for motion and path generation.
 Topic No 12 Velocity and Acceleration in Mechanism:
 Topic No 13 Velocity and acceleration analysis of simple mechanisms,
 Topic No 14 graphical velocity analysis using instantaneous centers,
 Topic No 15 Coriolis component of acceleration,

UNIT II

Cams and Followers:

Topic No16 Classification of cams and followers,
 Topic No17 Terminology, Cam profile by graphical methods with knife edge and radial roller follower for Uniform velocity,
 Topic No18 Parabolic, Simple harmonic and Cycloidal motions,

Gears and Gear Trains:

Topic No 19 Classification & Terminology, Law of gearing
 Topic No 20 Tooth Profile, Length of path of contact
 Topic No 21 Contact ratio, Interference & Under cutting in Involute gear teeth
 Topic No 22 Gear Trains- Synthesis of simple, Compound and Epicyclic gear train

UNIT III

Balancing of Rotating Components:

Topic No 23 Balancing of rotating masses,
 Topic No 24 Graphical and analytical methods

Balancing of Reciprocating Parts:

Topic No 25 Primary and secondary forces and couples
 Topic No 26 Partial balancing, Effects of partial balancing
 Topic No 27 Balancing of single cylinder, multi cylinder; inline and radial engines

UNIT IV

Gyroscopes –

Topic No 28 Gyroscopic couple and their effects on Aircrafts and Ship during steering

Topic No. 29 rolling and pitching

Topic No 30 Stability of two wheel and four wheel vehicles is moving on curved paths, Problems

Governors:

Topic No 31 Terminology, Centrifugal governors-Watt, Porter

Topic No 32 Proell and Hartnell governor

Topic No 33 Controlling force diagrams

TEXT BOOKS:

1. Theory of Machines - Thomas Bevan, CBS Publishers & Distributors
2. Mechanisms of Machines - Cleghorn W.L., Oxford University Press
3. Kinematics and Dynamics of Machinery, Robert L. Norton, Tata McGrawHill

REFERENCE BOOKS:

1. Theory of Mechanisms and Machines- Ghosh A. and Mallick A.K., Affiliated East- West Pvt. Ltd, New Delhi,
2. Mechanism and Machine Theory: J.S. Rao and R.V. Duddipati Second Edition New age International
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York
4. Theory and Machines: S.S. Rattan, Tata McGraw Hill.
5. Kinematics of Machines-Dr. Sadhu Singh, Pearson Education

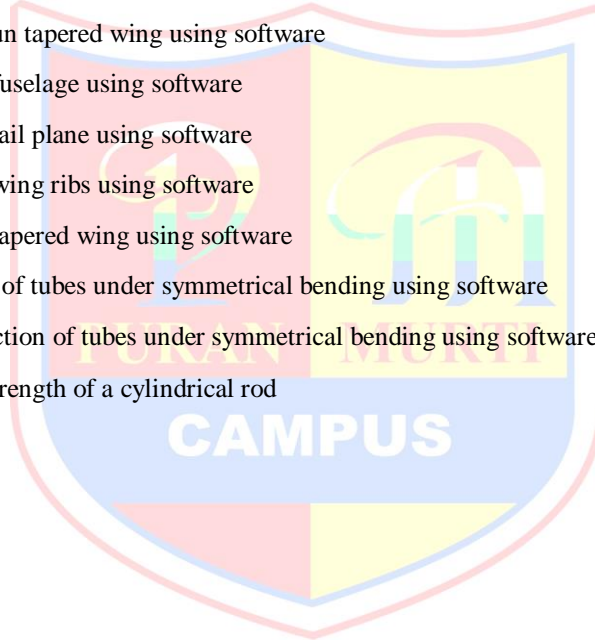


Subject: AIRCRAFT STRUCTURAL ANALYSIS AND DESIGN Lab.**Subject Code: AER 309 C**

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 0 | 0 | 2 | 1 | 25 | 75 | 3 hours | 100 |

S. No. LIST OF EXPERIMENTS

1. Stress analysis of landing gear using software
2. Stress analysis of statically determinate truss using software
3. Stress analysis of un tapered wing using software
4. Stress analysis of fuselage using software
5. Stress analysis of tail plane using software
6. Stress analysis of wing ribs using software
7. Stress analysis of tapered wing using software
8. To study the slope of tubes under symmetrical bending using software
9. To study the deflection of tubes under symmetrical bending using software
10. To study fatigue strength of a cylindrical rod



Subject: COMPRESSIBLE AND FINITE WING AERODYNAMICS Lab
Subject Code: AER 311 C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 0 | 0 | 2 | 1 | 25 | 75 | 3 hours | 100 |

S. No. LIST OF EXPERIMENTS

1. To determine pressure distribution over a cambered airfoil using software
 2. To determine C_p distribution over a Delta wing with different aspect ratios using subsonic wind tunnel.
 3. To determine boundary layer thickness over a symmetrical airfoil at different locations using subsonic wind tunnel.
 4. To determine boundary layer thickness over a cambered airfoil at different locations using subsonic wind tunnel.
 5. To determine boundary layer thickness over a Delta wing at different locations using subsonic wind tunnel.
- Flow visualization over a delta wing in smoke tunnel
6. To determine C_p distribution over a swept back wing using subsonic wind tunnel.
 7. To determine pressure distribution over a delta wing using software
 8. To determine pressure distribution over a swept back wing using software
 9. To determine C_p distribution over a Delta wing with different aspect ratios using subsonic wind tunnel.
 10. To determine pressure distribution over a swept forward wing using software

NOTE:

1. Ten experiments are to be performed in the Semester.
2. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus

Subject: Essence of Indian Traditional Knowledge

Subject Code: HUM 301 C

| Study Scheme | | | | Evaluation Scheme | | | Total Marks |
|-------------------|---|---|---------|---------------------|-----------------------------------|---------------|-------------|
| Lectures per week | | | | Internal Assessment | External Assessment (Examination) | | |
| L | T | P | Credits | Max. Marks | Max. Marks | Exam Duration | |
| 3 | 0 | 0 | - | 25 | 75 | 3 hours | 100 |

COURSE OBJECTIVE

- To introduce students to the basics of Indian knowledge traditions and forms
- To impart basic principles of thought process, reasoning and inferencing

UNIT 1 Indian Knowledge Traditions and Processes: An Overview

TOPIC NO 1 Vedic Tradition,
TOPIC NO 2 Epical Tradition,
TOPIC NO 3 Sutra Tradition,
TOPIC NO 4 Scholastic Tradition

UNIT II Vedic and Upnishadic Traditions

TOPIC NO 5 Vedic Mantras: Hymn of Creation, To Vāk
TOPIC NO 6 Upnishadic Narratives: The Story of Nachiketa

UNIT III Epical Insights

TOPIC NO 7 Gyanmarg (The Yoga of Wisdom)

UNIT IV Folk Wisdom

TOPIC NO 8 Folk Tales as knowledge: “The Blind Man and an Elephant”#
TOPIC NO 9 “The Goat who saved the Priest”,
TOPIC NO 10 “ Buried Treasure” , “ Little Prince, No Father” ,
TOPIC NO 11 “ Demons in the Desert”##
TOPIC NO12 “The Story of Meddlesome Monkey” ,
TOPIC NO13 “ The Story of the Lion and the Rabbit”
TOPIC NO 14 “The Story of Three Fishes””The Story of Dharmabudhi amnd Papabuddhi”###
TOPIC NO 15 Haryanvi Ragini as Moral lesson: Raja Harishchandra

- explain Indian traditional knowledge systems
- Relate life and learning with traditional knowledge in present times

PEDAGOGY

Through lectures, self study, group discussion, Projects and seminar

RECOMMENDED READING

1. Mitchell, Stephen. The Bhagavad Gita. Harmony Books, 2007 (Ch.4 for UNIT III).
2. Radhakrishnan, S. & Charles A. Moore. eds. A Source Book in Indian Philosophy. Princeton UP, 1957 (“General Introduction: History of Indian Thought” for UNIT I, Ch.1-2 for UNIT II))
3. ###Sharma, Vishnu. Panchatantra. Translated by Rohini Chowdhury. Puffin Books.
4. Sharma, Puran Chand. Pundit Lakhmi Chand Granthavali. Haryana Sahitya Akademi, 2010.
5. # <https://www.peacecorps.gov/educators/resources/story-blind-men-and-elephant/>
6. ## [www. buddhanet.net](http://www.buddhanet.net)

