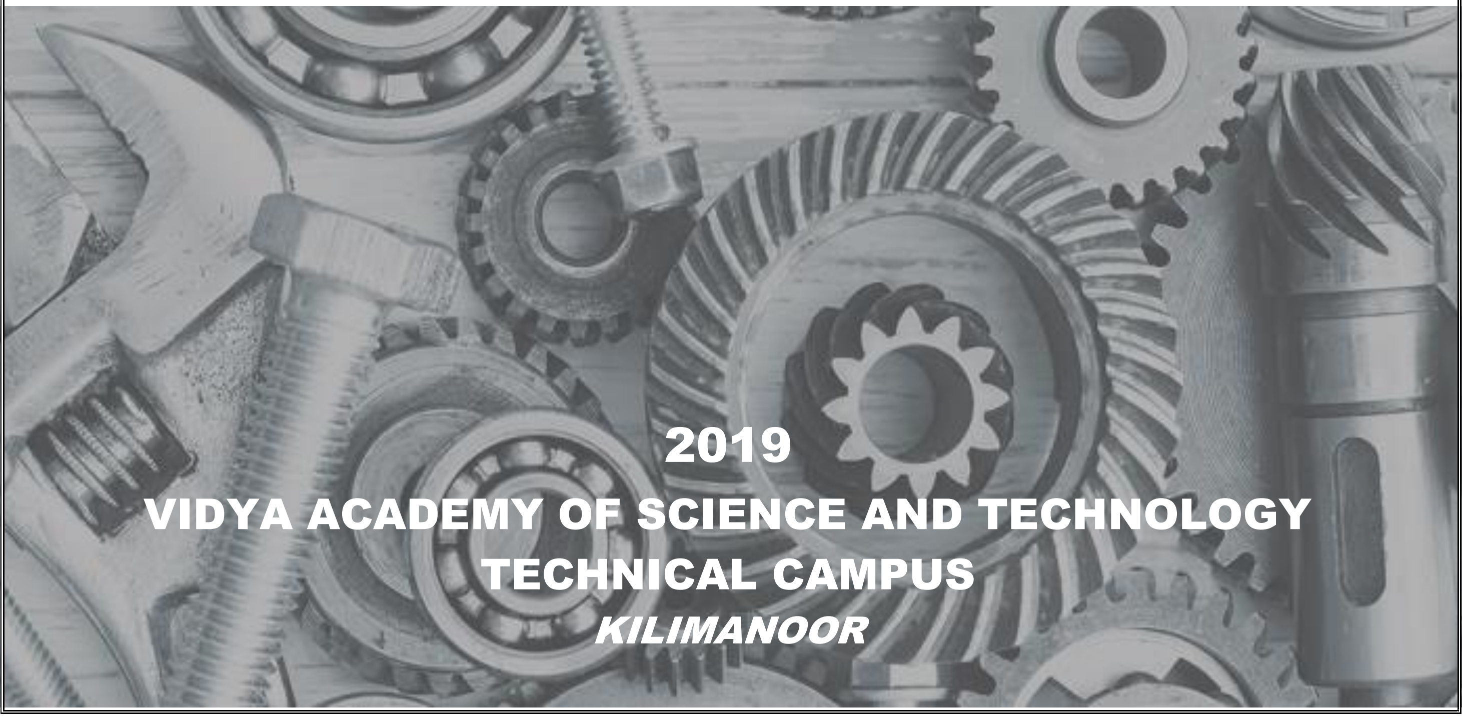
S3 QUESTION BANK

DEPARTMENT OF MECHANICAL ENGINEEERING



2019

VIDYA ACADEMY OF SCIENCE AND TECHNOLOGY
TECHNICAL CAMPUS
KILIMANOOR

SUB CODE ME 210 SUBJECT NAME METALLURGY AND MATERIALS ENGINEERING

MODULE 1

1 Differentiate between HCP and FCC crystal structures?

2 Prepare a brief note about polymorphism.

3 What is the difference between polymorphism and allotropy?

4 Which are the allotropic forms of iron?

5 What are the common features of graphite and diamond?

6 What is the importance of Miller indices? Explain the procedure for determining Miller indices for a plane.

7 What are crystallographic planes?

8 Explain schmid’s Law.

9 What is plastic deformation?

10 What is slip plane? How is it related to dislocation?

11 Describe the plastic deformation of metals.

12 What is critical shear? Explain.

13 Differentiate between slip and twin? Differentiate between their mechanisms

14 What is the APF for SC and BCC?

15 Explain the terms 'atomic packing factor' and 'co-ordination number'.

MODULE 2

1 What is meant by surface defects? List the type of surface defects observed in crystalline materials.

2 What is a line defect? What are the two types of line defects? Explain.

3 Explain briefly about Frank Read source.

4 Explain point defects.

5 What is the difference between edge and screw dislocation.

6 Give an account of equiaxial and dendritic grains

7 Explain Burgers circuit for screw dislocations.

8 Give an account of Fick’s laws of diffusion

9 State some of the general techniques used for the study of microstructure of metals.

10 What is self-diffusion?

11 Explain the diffusion process briefly.

12 Discuss vacancy diffusion and interstitial diffusion with neat sketches.

13 Derive an expression for diffusion coefficient.

14 Explain different types of point defects/ Explain the following point imperfections (a)vacancy (b) interstitial (c) Frenkel defect

15 Distinguish between homogeneous and heterogeneous nucleation.

SUB CODE ME 210 SUBJECT NAME METALLURGY AND MATERIALS ENGINEERING

MODULE 3

1. How are solid solutions classified? What are the two types of solid solutions? Give examples.What are the possible kinds of solid solutions?
2. State Hume Rothery rules. Explain various Hume Rothery rules for solid solution formation.
3. Discuss significance of Gibb's phase rule. What are its applications?
4. Differentiate between a pure metal and an alloy
5. Differentiate between eutectic and eutectoid reactions.
6. Differentiate between peritectic and peritectoid reactions.
7. Explain the lever rule with reference to equilibrium diagrams.
8. What is Fe_3 C? How does it affect the properties of steel?
9. Explain the features of ferrite, pearlite, austenite, ledeburite, cementite, bainite and martensite.
10. Differentiate between austenite, cementite and martensite.
11. Distinguish between hardening and case hardening.
12. Distinguish between annealing and isothermal annealing?
13. Define hardenability. Distinguish between hardness and hardenability.
14. What do you mean by spheroidizing?
15. What is autempering? What are its advantages and limitations?
16. What is martempering? What are its advantages and limitations?

MODULE 4

1. List the factors which affect recrystallization temperature.
2. What benefits are achieved through the process of recrystallization?
3. Distinguish between the terms, recovery and recrystallization involved in the process of heating (annealing) cold worked metals.
4. What are the applications of gray cast iron?
5. Write a note on classification of cast irons?/What are cast irons? Name different types of cast irons.
6. What are the applications of high speed steels?
7. What are chromium steels?
8. What is meant by work hardening or strain hardening? Explain.
9. Explain annealing after work hardening./ Discuss recovery, recrystallization and grain growth
10. Explain strengthening by grain refinement.
11. Explain the microstructure of cast irons.
12. Discuss on various strengthening mechanisms.
13. Describe the properties and applications of any two magnesium alloys.
14. What are nodular cast irons? What are their uses in engineering field?

15 What is gunmetal? Enumerate its properties and applications.

MODULE 5

1 What is an S-N curve? Draw the S-N curves for ferrous and non-ferrous alloys.

2 Draw S-N curves for Ti and Al. Indicate its importance.

3 Explain the mechanism of fatigue.

4 What are the factors leading to crack formation and crack propagation?

5 What is meant by stress raiser or stress concentration?

6 Define fracture toughness.

7 Define fatigue. What is endurance limit?/Define fatigue limit.

8 What is transgranular fracture?

9 Explain Griffith theory of brittle fracture./Explain Griffith's crack theory.

10 What are the factors that affect fatigue strength?

11 What are the salient features of brittle fracture?

12 What is the significance of ductile to brittle transition temperature?

13 What are the factors favoring brittle fracture? Explain their roles.

14 Explain the fatigue failure of metals. Discuss the factors that affect fatigue. Discuss the mechanism of fatigue.

15 Explain the different types of fatigue loading. Explain the effects of stress concentration, size effect and surface texture on fatigue.

MODULE 6

1 Write a note on creep resistant materials.

2 What is superplasticity? Explain with example.

3 Draw a typical creep curve and mark different zones./ What is a creep curve

4 Define creep. Write a short note on creep. Write a note on mechanism of creep.

5 Explain the features of smart materials./ What are smart materials? Explain.

6 Write a short note on metal matrix materials./What are the properties of metal matrix materials?/List the advantages of metal matrix composites.

7 How are composite materials classified?

8 What is a composite? Give examples.

9 What is meant by maraging steel?

10 What is meant by shape memory alloys? How does it achieve the effect?

11 Write a note on materials for bio (medical) applications.

12 List out the features of super alloys.

13 What are the different types of composites? Give applications for each type.

14 Differentiate between particle reinforced and fiber reinforced composites.

15 Explain smart materials and materials with memory.

SUB CODE ME 203 SUBJECT NAME MECHANICS OF FLUIDS

MODULE 1

1 What is meant by viscosity? Explain the importance of viscosity in real fluid motion?

2 Define Newtonian and non-Newtonian fluids with examples

3 Distinguish between mechanical gauges and manometer for measuring pressure

4 Distinguish between mechanical gauges and manometer for measuring pressure

5 How will you determine the Metacentric height of a floating body experimentally? Explain with a neat sketch.

6 Discuss the stability of floating bodies and submerged bodies.

7 What is Metacentric height? How it influence the stability of floating body?

8 The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 650 RPM. Calculate the power lost in the bearings for a sleeve length of 100 mm. Thickness of oil film is 1.5 mm

9 Derive an expression for the depth of centre of pressure from the free surface of liquid of an inclined plane surface submerged in the liquid and also the magnitude of the total force exerted by the liquid on the inclined plane surface

10 . A rectangular box is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the box is 0.8 m in the sea water (S = 1.025) . If the centre of gravity is 0.6 m above the bottom of the box, determine the Metacentric height.

11 A U-tube differential manometer connects two pressure pipes A and B. Pipe A contains carbon tetrachloride having a specific gravity 1.6 under a pressure of 15 N/cm2 and pipe B contains oil of specific gravity 0.8 under a pressure of 10 N/cm2 . Pipe A lies 2.5 m above pipe B and mercury level in the limb communicating with pipe A lies 4 m below pipe A. Find the difference in level of mercury in the two limbs of the manometer.

12 A vertical dock gate separates two water reservoirs of depth H1 and H2. Find the resultant pressure exerted on the gate and the point of its application if H1/H2 = 2. To what position does this line tend as the depth of water in both sides becomes equal

13 A cylindrical body 1.6 m in diameter and 1.3 m in length weighing 5 kN floats in sea water with its axis vertical. A 500 N load is placed centrally at the top of the body. If the body is to remain in stable equilibrium, find the maximum permissible height of the centre of gravity of the load above the top of the body

14 A solid cylinder of 4 m diameter has a height of 3 m when it is floating in water with its vertical axis. The specific gravity of cylinder is 0.6. State whether it is in stable or unstable equilibrium

15 A circular plate of 3 m in diameter is immersed in a liquid of specific gravity 0.8 with its plane making an angle of 30^0 with horizontal. The centre of the plate is at a depth of 2.75 m from the free surface. Calculate the total pressure on one side of the plate and location of centre of pressure.

SUB CODE ME 203 SUBJECT NAME MECHANICS OF FLUIDS

MODULE 2

1 Compare Lagrangian and Eulerian method of describing fluid motion, with examples

2 Define the following and give practical examples for each. (a) Laminar and turbulent flow (b) Uniform and non uniform flow

3 Derive equation of continuity for a three dimensional incompressible flow.

4 Define stream line, Path line and Streak line..

5 Define the terms Vorticity and Circulation in two dimensional fluid flow and show how they are related to each other.

6 What is stream function? Give its physical concept

7 Show that velocity potential exists in an irrotational flow

8 Show that velocity potential and the stream function must satisfy the Laplace equation

9 What is Cauchy-Reman equation.

10 Derive two dimensional continuity equation

11 A circular tank of diameter 4 m contains water up to a height of 5 m. The tank is provided with an orifice of diameter 0.5 m at the bottom. Find the time taken by water to (a) fall from 5 m to 2 m (b) for complete emptying the tank. Take Cd = 0.6.

12 In a two dimensional flow velocity components are given by u= x4 y and v = -y-4x. Check for the existence of velocity potential function and obtain the velocity potential function if exist

13 The velocity potential for a two dimensional flow is $\phi = x(2y-1)$. Determine the velocity at the point P(3,5). Also obtain the stream function at this point P

14 An idealized flow is given by $V = 2x^3 i - 3x^2 y j$. Is the flow is steady or unsteady ? Is it two or three dimensional? Make calculation for the velocity, local acceleration and convective acceleration of a fluid particle in the flow field at point (2,1,3)

15 A fluid flow field is given by V = x2 y i + y 2 z j - (2xyz + yz2) k. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2,1,3)

MODULE 3

1 What are the different forms of energy in a flowing fluid? Represent schematically the Bernoulli's equation for flow through a tapering pipe and show the position of total energy line and datum line

2 What is Euler's equation of motion? How will you obtain Bernoulli's equation from it?

3 Mention the advantages and limitations of an orifice meter as a flow measuring device.

4 The discharge through a venturimeter depends upon the piezometer difference only and is independent of the orientation of the meter. Discuss the correctness of this statement.

5 What is a Pitot tube? How will you determine the discharge with the help of a Pitot tub

6 Explain the difference between Pitot tube and Pitot static tube

7 What is the difference between momentum equation and impulse momentum equation?

8 Explain why the length of divergent part of venturimeter is more that of convergent part?

9 What is a notch? How is it different from a large orifice?

10 State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation

11 Derive an expression for the discharge over a rectangular notch for a given head of water over the sill

12 Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm2 and the pressure at the upper end is 9.81 N/cm2 . Determine the difference in datum head if the rate of flow through pipe is 40 lit/s

13 . A pump has a tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of Hg vacuum, while the pressure at the lower end is 15 kN/m2 . Assume the head loss to be 20% of difference of velocity head. Calculate the discharge, the flow is vertically upward and difference of elevation is 3.9 m

14 A nozzle of diameter 20 mm is fitted to a pipe of diameter 40 mm. Find the force exerted by the nozzle on the water which is flowing through the pipe at the rate of 1.2 m3 /min

15 A 45^0 reducing bend is connected in a pipe line, the diameter at outlet and inlet of the pipe bend being 20 cm and 40 cm respectively. Find the force exerted by the water on the pipe DEPARTMENT OF MECHANICAL ENGINEERING VAST TC Page 5 bend if the intensity of pressure at inlet of bend is 21.58 N/cm2 .The rate of flow of water is 500 lit/s.

MODULE 4

1 Explain Moody's chart. What is its use in pipe flow?

2 What do you understand by the terms : major losses and minor losses in pipes

3 Differentiate between hydraulic gradient line and total energy line

4 Describe the concept of equivalent pipe.

5 Explain how the equivalent diameter of a compound pipe is determined?

6 What is a Syphon? What are its applications? Explain its action.

7 What do you mean by water hammer?

8 Find the critical velocity of oil at 10^0 C flowing through a 15 cm diameter pipe. Take kinematic viscosity of oil as 0.041 stokes

9 In a pipe of diameter 200 mm and length 500 m an oil of specific gravity 0.9 and viscosity 0.06 poise is flowing at the rate of 0.06 m3 /s. Find (a) head lost due to friction. (b) power required to maintain the flow.

10 Derive and expression for head loss due to sudden enlargement of pipe. List all the assumptions made in the derivation

11 Derive an equation to find the loss of head or energy in pipes due to friction

12 Derive an expression for loss of head due to sudden expansion of flow in a pipe line

13 The old water supply distribution pipe of 250 mm diameter of a city is to be replaced by two parallel pipes of smaller diameter having equal length and identical friction factor value 5. Find the diameter of new pipes required

14 Briefly explain about Reynold's experiment

15 Derive Darcy weisbach equation for major loss in pipes

MODULE 5

1 What do you understand by the boundary layer? Illustrate with reference to flow over a flat plate.

2 Explain the concept of displacement and momentum thickness.

3 What do you understand by boundary layer separation. Mention the reasons for boundary layer separation.

4 Distinguish between turbulent boundary layer and laminar sub-layer

5 Obtain Von Karman momentum integral equation

6 Derive the expression for momentum thickness for boundary layer flows

7 Explain boundary layer separation. How it can be controlled?

8 A smooth plate 2 m wide and 2.5 m long is towed in an oil (relative density = 0.8) with a velocity of 1.5 m/s lengthwise. Find the boundary layer thickness and shear stress at the centre and trailing edge of the plate. Also find the power required for towing the plate. Take kinematic viscosity of oil is 10^{-4} m 2 /s

9 Calculate the friction drag on a plate 15 cm wide and 4.5 cm long placed longitudinally in a stream of oil (s = 0.925 and ν = 0.9 stokes) flowing with a free stream velocity of 6 m/s. Also find the thickness of the boundary layer and shear stress at trailing edge

10 . Find the power required to tow a plate of dimensions 1.25 m x 3 m in water at 20^0 C. (kinematic viscosity = 9.3 * 10^{-3} stokes) with 3 m side in the flow direction, at 1 m/s velocity. Make allowance for the fact that the boundary layer changes from laminar to turbulent on the plate. Find the length of the plate over critical Reynold's number as 5 x 10^5

MODULE 6

1 Explain Reynold's law for similitude and derive the expression for velocity, time and force ratio

2 Explain the significance of dimensional analysis as applied to fluid flow problems?

3 Define the term dimensional analysis and model analysis?

4 Define following dimensionless numbers and state their significance for fluid flow problems (a) Reynold's number (b) Froude number (c) Mach number

5 What are the different laws on which models are designed for dynamic similarity? Where are they used?

6 State Buckingham's Π -Theorem? Why this theorem is considered superior over the Rayleigh's method for dimensional analysis?

7 Define the following dimensionless numbers and state their significance

8 Distinguish between distorted and undistorted models, where distorted models are used

9 A 2.5 m ship model was tested in fresh water and measurements indicated that there was a resistance of 45 N when the model was moved at 2 m/s. Work out the velocity of 40 m prototype. Also calculate the force required to drive the prototype at this speed through sea water. Density of fresh water = 1000 kg/m3 and density of sea water = 1025 kg/m^3.

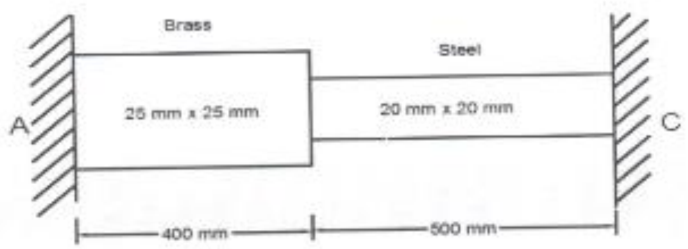
10 A 1/6 scale model automobile is tested in a wind tunnel in the same air properties as the prototype. The prototype automobile runs on the road at a velocity of 50 km/hr. For dynamic similarity conditions, the drag measured on the model is 300 N. Make calculation for the drag of the prototype and the power required to overcome this drag.

MECHANICS OF SOLIDS

MODULE I

UNIVERSITY QUESTIONS

1. Explain the stress-strain curve of a mild steel bar in tension test. ***(KTU; Jan. 2017)***
2. A straight bar 450mm long is 40mm in diameter for the first 250mm length and 20mm diameter for the remaining length. If the bar is subjected to an axial pull of 15kN. Find the maximum and minimum stresses produced in it and the total extension of the bar. Take E= 2x 10^5 N/mm^2.
   (KTU; Jan. 2017)
3. A bar made of brass and steel as shown in figure is held between two rigid supports A and C. Find the stress in each material if the temperature rises by 40^0C. Take E_b = 1x10^5 N/mm^2, α_b = 19x10^{-6}/^{0}C, E_s = 2x10^5 N/mm^2, α_s = 12x10^{-6}/^{0}C. ***(KTU; Jan. 2017)***



4. Explain elastic limit, Hook's law, Poisson's ratio. ***(KU; Dec. 2015)***
5. Define volumetric strain ***(KU; Apr. 2015)***
6. Explain: ***(KU; Jan. 2015)***
   a. Constitutive relation
   b. Principle of superposition
7. Define Thermal stress and derive an expression for the stress developed in a bar restrained at both the ends subjected to an increase in temperature. ***(KU; Nov. 2014)***
8. Explain Hook's law. ***(KU; Sep. 2014)***

MODULE II

UNIVERSITY QUESTIONS

1. **a)** What is stress tensor? Explain different ranks of a tensor. ***(KTU; Jan. 2017)***

   b) A cylindrical bar is 20mm diameter and 800mm long. During a tensile test it is found that the longitudinal strain is 4 times the lateral strain. Calculate the modulus of rigidity and bulk modulus, if its elastic modulus is 1x10^5 N/mm^2. Find the change in volume, when the bar is subjected to hydrostatic pressure of 100N/mm^2.

2. A solid shaft of 6m length securely fixed at each end. A torque of 80 Nm is applied to the shaft at a section 2m from one end. ***(KTU; Jan. 2017)***

a) Find the fixing torques setup at the ends of the shaft.

b) If the shaft is of 50mm diameter, find the maximum shear stresses in the two portions.

c) Find the angle of twist for the section where the torque is apllied.

Take C = 10^5 N/mm^2.

3. Explain Saint Venant's principle ***(KU; Jan. 2016)***

4. Give the assumptions made in the theory of Torsion. Write down the Torsion formula

(KU; Dec. 2015)

5. Derive expression to find the stresses developed in a body when it is subjected to impact load.

(KU; Dec. 2015)

6. Find the values of maximum and minimum principal stresses in a block subjected to two tensile stresses 80 Mpa and 60 Mpa along with a shear stress of 40 Mpa**.** ***(KU; Dec. 2015)***

7. A metallic bar 250mmx80mmx30mm is subjected to a force of 20kN (tensile), 30kN (tensile) and 15kN (tensile) along the x, y and z directions respectively. Determine the change in the volume of the block. Take E = $2x10^5$ N/mm^2 and Poisson's ratio = 0.25.

(KU; Apr. 2015)

8. The stresses at a point in a bar are 200 N/mm^2 (tensile) and 100N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60^0 to the axis of the major stress. Also determine the maximum intensity of shear stress in the material at the point.

(KU; Apr. 2015)

MODULE III

UNIVERSITY QUESTIONS

1. Draw SFD and BMD for the overhanging beam shown in figure. Locate the points of contraflexure. Also determine the maximum bending moment.

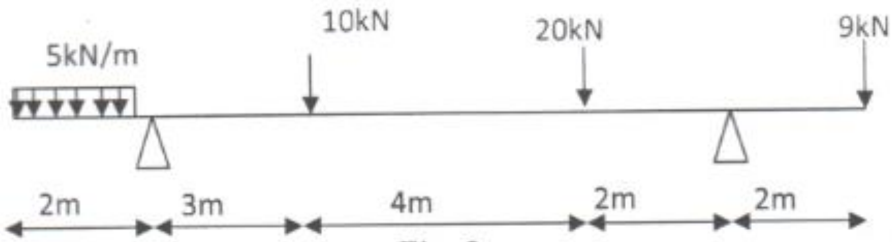


Fig. 2

(KTU; Jan. 2017)

2. **a)** Derive the relation between intensity of loading, shear force and bending moment at a section of uniformly loaded beam

b) A simply supported beam of length 4m carries a uniformly distributed load of 3kN/m over the central 2m length and two point loads 2kN and 3kN at distances 0.5m and 3.5m from the left support. Draw SFD and BMD. Locate the point of maximum bending moment and find out the maximum bending moment.

(KTU; Jan. 2017)

3. Sketch the Mohr's circle for the following cases:

a. An element subjected to pure shear

b. An element subjected to tensile stresses of same magnitude on perpendicular planes.

(KU; Jan. 2016)

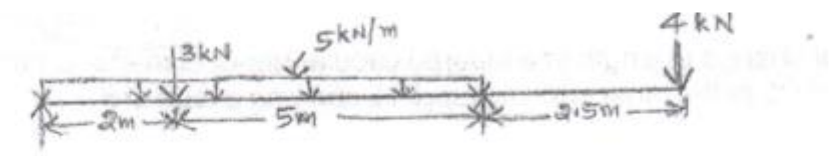
4. In theory of pure bending, plane cross sections are assumed to remain plain even after bending. What are the consequences of this assumption? ***(KU; Jan. 2016)***

5. Draw the shear force and bending moment diagrams for a simply supported beam with equal overhang on either side carrying uniformly distributed load 'w' per unit run over the whole length. Span length is 'l' and overhanging length is 'a'. Consider the three cases of l > 2a

(KU; Dec. 2015)

6. Derive the expression for for shear stresses for an I beam and plot the variation of stresses across the section. ***(KU; Dec. 2015)***

7. Determine the values of shear force and bending moment and draw the diagrams for the beam loaded as shown. ***(KU; Dec. 2015)***



8. Explain Lame's equation. ***(KU; Apr. 2015)***

9. A steel rod 5cm diameter and 6m long is connected to two grips and the rod is maintained at a temperature of 100^0C. Determine the stress and pull exerted when the temperature falls to 20^0C if :

a. The ends do not yield and

b. The ends yield by 0.15 cm.

Take $E = 2x10^5$ N/mm^2 and $\alpha = 12x10^{-6}$ /^{0} C. ***(KU; Apr. 2015)***

MECHANICS OF SOLIDS

MODULE IV

UNIVERSITY QUESTIONS

1. a) Explain how beams of uniform section can be designed in practice

b) At the critical section of a I beam, the value of vertical shear force is 40kN and the sectional dimensions are :- Flange width- 200mm, Flange thickness- 30mm, web thickness- 40mm and total depth- 300mm. Draw the shear stress distribution across the depth of the section.

(KTU Jan.2017)

2. a) Two steel rods 2.5m long and 20mm diameter and 1 copper rod 2m long and 20mm diameter together support a load of 30kN. The loaded end is at the same level and the other end is rigidly fixed. Find the stresses in the rods. E_s = 210kN/mm^2 ,E_c = 110kN/mm^2

(KU; Apr.2015)

3. In a tensile test a test piece 25mm in diameter, 200mm gauge length stretched 0.0975mm under a pull of 50kN. In a torsion test the same rod is twisted to 0.025radian over a length of 200mm, when a torque of 400Nm was applied. Evaluate the poisons ratio and the three elastic moduli for the material.

(KU;Apr.2015)

4. a) Find the minimum diameter of a steel wire , which is used to raise a load of 4000N if the stress in the rod is not to exceed 95MN/m^2.

b) An axial pull of 40kN is acting on a bar consisting of 3 sections of length 30cm, 25cm and 20cm and of diameters 2cm, 4cm and 5cm respectively. If E= 2x10^5 N/mm^2, Determine

i) Stress in each section.

ii) Total extension of the bar.

(KU; Apr.2015)

5. Calculate the maximum bending stress in a cantilever beam of span 2m subjected to a UDL of 1kN/m over full length. Cross section of the beam is 100x150mm.

(KU; Jan.2015)

6. The angle of twist of a 4m length of shaft whose diameter is 100mm is observed to be 0.05radian when the shaft is revolving at 250rev/min. If the modulus of rigidity is 80 GN/m^2, find the power transmitted and the maximum shear stress. ***(KU; Jan.2015)***

7. Determine maximum and minimum principal stresses in block subjected to two stresses of 100MPa(tensile) and 50MPa(compressive) along with a shear stress of 30MPa.Find also the angle of inclination of principal planes and the normal and tangential stress in a plane inclined at an angle of 30 degrees (counter clock wise) with the vertical plane carrying tensile stress. Verify answer using Mohr’s circle. ***(KU;Sep.2014)***

8. Explain the principle of super position to evaluate total strain of axially loaded bars.

MODULE V

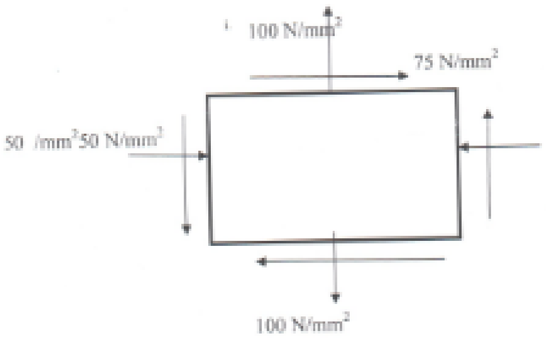
UNIVERSITY QUESTIONS

1. A beam of length 6m is simply supported at its ends and carries two point loads of 48kNand 40kN at a distance of 1m and 3m respectively from the left support. Find the deflection under each load and the maximum deflection by Macaulay's method. Given E= $2x10^5$ N/mm^2 and I= $85x10^6$ mm^4.

   (KTU;Jan.2017)

2. State of stress at a point in a material is 100N/mm^2 (tensile) upon a horizontal plane and 50N/mm2 (compressive) upon a vertical plane. These planes also carry a shear stress of 75N/mm^2 as shown in fig. Determine principal stresses, maximum shear stress, plane of maximum shear stress and the resultant stress on the plane of maximum shear stress.

   (KTU;Jan.2017)



3. Explain double integration method to find the deflection of a cantilever beam with a point load at the free end ***(KTU;Jan.2017)***

4. Explain the terms:

   a. Principal planes and principal stresses

   b. Mohr's circle of stresses

   c. Strain rosettes ***(KTU;Jan.2017)***

5. A circular cast iron column of diameter 250mm carries a vertical load of 600kN at a distance of 35mm from the axis. Find the extreme values of stresses induced in the section

   (KU;Dec.2015)

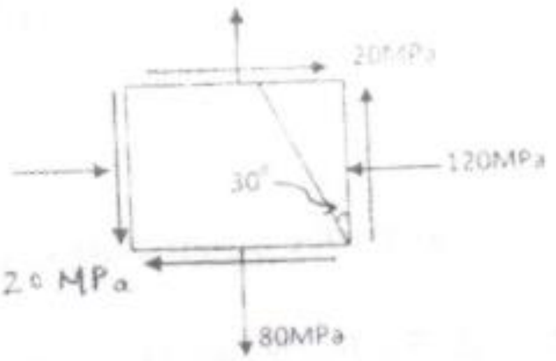
6. The simply supported beam of span 5m carries a uniformly distributed load of 5kN/m over its right half span along with a point load of 15kN at 1.5m from left support

7. Calculate slope at supports and deflection at mid span. Take flexural rigidity as $3x10^4$kN-m^2. ***(KU;Jan.2015)***

8. Determine the principal stresses and principal planes in an element subjected to stresses as shown. Also calculate

a. Maximum shear stress and its plane

b. Stress conditions in the plane shown ***(KU; Nov.2014)***



MODULE VI

UNIVERSITY QUESTIONS

1. Derive Euler's buckling load for slender columns with ends hinged ***(KTU;Jan.2017)***

2. A 1.5m long column has a circular cross section of 5cm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, calculate the safe load using Rankin's formula, take yield stress as 560 N/mm2 and α = 1/1600 for pinned ends

(KTU;Jan.2017)

3.Determine the buckling load for a strut of T-section,the flange width being 150mm, overall depth 100mm and both flange and web 13mm thick. The strut is 3m long and is hinged at both ends. Take E=200GPa

(KU;Apr.2015)

4. Calculate the safe compressive load on a hollow cast iron column whose one end is rigidly fixed and other end is hinged. The external diameter is 200mm and internal diameter 150mm and 8m length. Use Euler's formula with a factor of safety of 3 and $E=2x10^5N/mm^2$. ***(KU;Dec.2015)***

5. List the assumptions made in the Euler's buckling theory. ***(KU; Dec.2015)***

6. What is the limitation of Euler's theory? ***(KU; Sep. 2014)***

SUB CODE ME205 SUBJECT NAME THERMODYNAMICS

MODULE 1

1 a) Explain classical approach in the study of thermodynamics. **(KU May 2015)**

b) Differentiate between work transfer and heat transfer

c) What are the different mechanisms for transferring energy to or from a control volume

2 Define thermometric property. Why is a gas chosen as standard thermometric substance

(**KTU January 2017)**

3 Explain temperature scale. How can the ideal gas temperature for the steam point be measured?

(**KTU January 2017)**

4 Show that work is a path function and not a property (**KTU January 2017)**

5 Explain thermodynamic equilibrium. (**KTU July 2017)**

6 What is quasi-static process? What is its characteristic feature? (**KTU July 2017)**

7 What is the concept of continuum? How will you define density and pressure using this concept?

(**KTU July 2017)**

8 Write short notes on

(a) Different forms of energy.

(b) System, boundary and surroundings.

(c) Point and path functions. (**KTU July 2017)**

MODULE 2

1 Calculate the internal energy and enthalpy of 1kg of air occupying 0.03m3 at 3MPa.

(**KTU January 2017)**

2 Explain Joule’s experiment with neat sketches and state first law. State first law for closed system undergoing a change of state and show that energy a property of system.

(**KTU January 2017)**

3 Define enthalpy. Why the enthalpy of an ideal gas does depend only on temperature?

(**KTU July 2017)**

4 A gas of 4 kg is contained within the piston cylinder machine. The gas undergoes a process for which $pV^{1.5}$ = Constant. The initial pressure is 3 bar and the initial volume is $0.1m^3$, and the final volume is $0.2m^3$. The specific internal energy of the gas decreases by 4.6kJ/kg. There is no significant change in KE and PE. Determine net heat transfer for the process.

(**KTU July 2017)**

5 Define specific heat and derive it for constant pressure and constant volume?(**KTU July 2017)**

6 A turbo compressor delivers 2.33 m^3/s at 0.276 MPa, 43°C which is heated at this pressure to 430°C and finally expanded in a turbine which delivers 1860 kW. During the expansion, there is a heat transfer of 0.09 MJ/s to the surroundings. Calculate the turbine exhaust temperature if changes in kinetic and potential energy are negligible? (**KTU July 2017)**

7 Write steady flow energy equation for a single stream entering and single stream leaving a control volume and explain the various terms in it. (**KTU July 2017)**

8 A pump steadily delivers water at a volumetric flow rate of $0.05m^3$/s through a pipe of diameter 18 cm located 100 m above the inlet pipe which has a diameter of 15 cm. The pressure is nearly equal to 1 bar at both the inlet and the exit, and the temperature is nearly constant at 20°C throughout. Determine the power required by the pump. Take g= 9.81 m/s^2

(**KTU July 2017)**

MODULE 3

1 Establish the equivalence of Kelvin-Plank and Clausius statements. (**KTU January 2017)**

(**KTU July 2017**

2 A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30kW. If the heat pump extracts 17kJ/s from 5°C reservoir. Determine (a) rate of heat supply from the 840°C source and (b) the rate of heat rejection to the 60°C sink**.**

(**KTU January 2017)**

3 A domestic food freezer maintains a temperature of -150C. The ambient air temperature is 300C. If heat leaks into the freezer at the continuous rate of 1.75KJ/S what is the least power necessary to pump this heat out continuously? (**KTU January 2017)**

4 A fluid undergoes a reversible adiabatic compression from 0.5MPa, 0.2m^3 to 0.05m^3 according to the law, $pv^{1.3}$ = constant. Determine the change in enthalpy, internal energy and entropy, and the heat transfer and work transfer during the process. **(KTU July 2017)**

5 Establish the Inequality of Clausius? **(KTU July 2017)**

6 Explain entropy principle and its applications? **(KTU July 2017)**

7 State and prove Clausius' theorem **(KTU July 2017**

8 A rigid vessel contains 1 kg of a mixture of saturated water and saturated steam at a pressure of 0.15 MPa. When the mixture is heated, the state passes through the critical point. Determine (i) The volume of the vessel. (ii) The mass of liquid and of vapour in the vessel initially. (iii) The temperature of the mixture when the pressure has risen to 3 MPa. (iv) The heat transfer required to produce the final state.

MODULE 4

1 Two kg of air at 500 kPa, 80°C expands adiabatically in a closed System until its volume is doubled and its temperature becomes equal to that of the surroundings which is at 100 kPa, 5°C. For this process, determine (a) the maximum work, (b) the change in availability and (c) the irreversibility. For air, take Cv = 0.718 kJ/Kg K, u = CvT where cv is constant, and pV = mRT where p is pressure in kPa, V volume in m^3, m mass in kg, R a constant equal to 0.287 kJ/kg K, and T temperature in K **(KTU January 2017)**

2 Explain mollier chart, P-V, P-T, P-V-T diagrams for pure substances. **(KTU January 2017)**

3 What is energy, dead state and triple point? **(KTU January 2017)**

4 A rigid vessel contains 1 kg of a mixture of saturated water and saturated steam at a pressure of 0.15 MPa. When the mixture is heated, the state passes through the critical point. Determine (i) The volume of the vessel (ii) The mass of liquid and of vapour in the vessel initially(iii) The temperature of the mixture when the pressure has risen to 3 MPa (iv) The heat transfer required to produce the final state. **(KTU January 2017)**

5 Steam initially at 0.3 MPa, 250°C is cooled at constant volume. (a) At what temperature will the steam become saturated vapour? (b) What is quality at 80°C? (c) What is the heat transferred per kg of steam in cooling from250°C to 80°C? **(KTU July 2017)**

6 What is the critical state? Draw the phase equilibrium diagram on p-v coordinates for a substance which shrinks in volume on melting. **(KTU July 2017)**

7 What is exergy, dead state and triple point? **(KTU July 2017)**

MODULE 5

1 Derive the equations used for computing the entropy change of an ideal gas. **(KTU January 2017)**

2 Two tanks are connected by a valve. One tank contains 2 kg of CO2 gas at 77°C and 0.2 bar. The other tank holds 8 kg of the same gas at 27°C and 1.2 bar. The valve is opened and the gases are allowed to mix while receiving energy by heat transfer from the surroundings. The final equilibrium temperature is 42°C. Determine the final equilibrium pressure and heat transfer for the process. **(KTU January 2017)**

3 a) Explain equation of state and law of corresponding state. **(KTU January 2017)**
Derive law of corresponding state from vanderwaals equation. **(KTU January 2017)**

4 a) State and explain Amagat's law of partial volumes of a gas mixture. **(KTU January 2017)**
A mass of 0.25 kg of an ideal gas has a pressure of 300 kPa, a temperature of 80°C, and a volume of 0.07 m3. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.10m3, during which work done on gas is 25 kJ. Evaluate the cp and cv of the gas and the increase in entropy of the gas. **(KTU January 2017)**

5 A certain gas has C_p = 0.913 and C_v = 0.653 kJ/kg K. Find the molecular weight and the gas constant R of the gas? **(KTU January 2017)**

6 a) Write down the van der Waals equation of state. How does it differ from the ideal gas equation of state? **(KTU July 2017)**
Express the changes in internal energy and enthalpy of an ideal gas in a reversible adiabatic process in terms of pressure ratio. **(KTU July 2017)**

7 Explain different properties of real gas mixtures and the laws associated. **(KTU July 2017)**

8 A supply of natural gas is required on a site 800 m above storage level. The gas at - 150°C, 1.1 bar from storage is pumped steadily to a point on the site where its pressure is 1.2 bar, its temperature 15°C, and its flow rate 1000 m^3/hr. If the work transfer to the gas at the pump is 15 kW, find the heat

transfer to the gas between the two points. Neglect the change in K.E. and assume that the gas has the properties of methane (CH_4, M =16) which may be treated as an ideal gas having $\gamma = 1.33$ (g = 9.75 m/s^2) **(KTU July 2017)**

MODULE 6

1 Derive Maxwell relations from basic thermodynamic relations? Explain their significance. **(KTU July 2017)**

2 Show that $C_p - C_v = -T \left[\frac{\partial V}{\partial T}\right]_p^2 \left[\frac{\partial P}{\partial V}\right]_T$ **(KU 2014 May)**

3 Show that $C_P / C_v = \left[\frac{\partial P}{\partial V}\right]_S \Big/ \left[\frac{\partial P}{\partial V}\right]_T$ **(KU 2014 May)**

4 Derive TDS Equations. **(KTU July 2017)**

5 What are Helmoholz function and Gibbs function? **(KU 2014 May)**

6 Explain Joule-Thomson coefficient and Inversion curve. **(KTU January 2017)**

7 Define adiabatic flame temperature. How is it estimated? **(KTU July 2017)**

What is enthalpy of combustion? What do you understand by higher heating value and lower heating value of fuel? **(KTU July 2017)**

8 Derive Clausius clapeyron equation

SUB CODE **ME205** **SUBJECT NAME** **THERMODYNAMICS**

Question Bank

THIRD SEMESTER (2019)

MA201 LINEAR ALGEBRA &COMPLEX ANALYSIS (FOR ALL BRANCHES)

Module I

Sl. No	Questions	Marks	KTU
1.	Show that $u = y^3 - 3x^2y$ is harmonic and hence find its harmonic conjugate.	8	DEC 2016
2.	Define an analytic function and prove that an analytic function of constant modulus is constant.	8	DEC 2016
3.	Check whether the following functions are analytic or not. Justify your answer i) $f(z) = z + \bar{z}$ ii) $f(z) = \|z\|^2$	4+4	MARCH2017
4.	Show that $f(z) = \sin z$ is analytic for all z. Find $f'(z)$	7	MARCH2017
5.	Show that $v = 3x^2y - y^3$ is harmonic and find the corresponding analytic function	8	MARCH2017
6.	. Let $f(z) = u(x,y) + i\,v(x,y)$ be defined and continuous in some neighbourhood of a point z = x+ iy and differentiable at z itself. Then prove that the first order partial derivatives of u and v exist and satisfy Cauchy- Reimann equations	7	ARIL 2018
7.	Prove that $u = \sin x \cosh y$ is harmonic.Hence find its harmonic conjugate.	8	ARIL 2018
8.	Check whether the function f(z) = $\frac{Re\,(z^2)}{\|z\|^2}$ if $z \neq 0$ = 0 if z = 0 is continuous at z=0	7	ARIL 2018
9.	Let f (z) = u+ iv is analytic ,prove that u = constant,v=constant are families of curves cutting orthogonally.	7	JULY2017
10	Prove that the function u(x, y) = $x^3 - 3xy^2 - 5y$ is harmonic everywhere . Also find the harmonic conjugate of u.	7	JULY2017
11	Find the points, if any, in complex plane where the function f(z)=$2x^2 + y + i(y^2 - x)$is (i) differentiable(ii) analytic	8	JULY2017
12	Find the analytic function whose imaginary part is v(x,y) = log($x^2 + y^2$) + $x - 2y$.	7	MAY 2019

Module II

Sl. No	Questions	Marks	KTU
1.	Find the image of $\left\|z - \frac{1}{2}\right\| \leq \frac{1}{2}$ under the transformation $w = \frac{1}{z}$ .Also find the fixed points of the transformation $w = \frac{1}{z}$	7	DEC2016
2.	Find the linear fractional transformation that maps the points $z_1 = 0, z_2 = 1, z_3 = \infty$ onto $w_1 = -1, w_2 = -i, w_3 = 1$ respectively.	7	DEC2016
3.	Find the image of the lines x = c and y = k where c and k are constants under the transformation w = $\sin z$	7	DEC2016

4.	Find the image of $0 < x < 1$, $\frac{1}{2} < y < 1$ under the mapping $w = e^z$	7	MARCH2017
5.	Find the linear fractional transformation that carries $z_1 = -2$, $z_2 = 0$ and $z_3 = 2$ onto the points $w_1 = \infty$ $w_2 = \frac{1}{4}$,$w_3 = \frac{3}{8}$ hence find the image of x axis	7	MARCH2017
6.	Find the image of the rectangular region $-\pi \le x \le \pi$, $a \le y \le b$ under the mapping $w = \sin z$	8	MARCH2017
7.	Find the image of the region $\left\|z - \frac{1}{3}\right\| \le \frac{1}{3}$ under the transformation $w = \frac{1}{z}$	8	APRIL 2018
8.	Find the image of the x axis under the linear fractional transformation $w = \frac{z+1}{2z+4}$	8	APRIL 2018
9.	Under the transformation $w = z2$, find the image of the triangular region bounded by = 1, y = 1 and $x + y$ = 1.	8	MAY 2019
10.	Find the bilinear transformation that maps the points $-1,i,-1$ onto $i,0,-i$.	8	MAY 2019
11.	Find the image of the half plane Re(z)≥ 2,under the map w=iz	8	JULY 2017
12.	Under the transformation $w = 1/z$, find the image of $\|z - 2i\| = 2$.	8	MAY 2019

Module III

1	Evaluate $\int_c Re(z)\, dz$ where is the straight line from 0 to 1+2i	7	DEC2016
2	Show that $\int_0^\infty \frac{1}{1+x^4}\, dx = \frac{\pi}{2\sqrt{2}}$	8	DEC2016
3	Integrate $\frac{z^2}{z^2-1}$ counter clockwise around the circle $\|z\_1\_i\| = \frac{\pi}{2}$	7	DEC2016
4	Evaluate $\int_c \|z\|$ dz i)where c is the line segment joining i and –i ii) where c is the unit circle in the left of the half plane	3+4	MARCH2017
5	Verify Cauchy's integral theorem for z^2 taken over the boundary of the rectangle with vertices -1,1,1+i,1-I in the counter clockwise sense.	8	MARCH2017
6	Evaluate $\int_c Im(z^2)\, dz$ where c is the triangle with vertices 0,1,i counter clockwise.	7	APRIL 2018
7	Use Cauchy's Integral Formula, evaluate $\int_c \frac{z^2}{z^3-z^2-z+1}\, dz$ where c is taken counter clockwise around the circle: i)$\|z+1\| = \frac{3}{2}$ ii)$\|z-1-i\| = \frac{\pi}{2}$	8	APRIL 2018
8	Find the Taylor series and Laurent series of $f(z) = \frac{-2z+3}{z^2-3z+2}$ with centre 0 in i)$\|z\| < 1$ ii$1 < \|z\| < 2$	8	APRIL 2018
9	Find the Laurent series expansion of $f(z) = \frac{1}{1-z^2}$ which is convergent in i)$\|z-1\| < 2$ ii) $\|z-1\| > 2$	8	MARCH2017
10	If $(z) = \frac{1}{z^2}$, find the Taylor series that converges in $\|z-i\| < R$ and the Laurent series that converges in $\|z-i\| > R$	8	DEC 2016
11	Using Cauchy's integral formula, evaluate $\int_c \frac{e^z}{(z^2+4)(z-1)^2}$ dz where C is the circle $\|z - 1\| = 2$	7	MAY2019
12	Evaluate $\int_0^{2+i} (\overline{z})^2$ dz along (i) the real axis to 2 and then vertically to 2 + i . ii) the line $2y = x$.	8	MAY2019

SUB CODE **ME205** **SUBJECT NAME** **THERMODYNAMICS**

Module IV

1	Define three types of isolated singularities with an example for each	7	DEC2016
2	Determine the nature and type of singularities of i) $\frac{e^{-z^2}}{z^2}$ ii) $\frac{1}{z}$	7	MARCH 2017
3	Use Residue theorem to evaluate $\int_c \frac{30z^2-23z+5}{(2z-1)^2\,(3z-1)}\,dz$ where c is $\lvert z\rvert = 1$	7	MARCH 2017
4	Evaluate $\int_0^\infty \frac{1}{(1+x^2)^2}\,dx$ using residue theorem	8	MARCH 2017
5	Determine and classify the singular points for the following functions i) $f(z) = \frac{\sin z}{(z-\pi)^2}$ ii) g(z) = $(z+i)^2 e^{\frac{1}{z+i}}$	7	APRIL 2018
6	Evaluate $\int_{-\infty}^{\infty} \frac{1}{(1+x^2)^3}\,dx$	8	APRIL 2018
7	Evaluate $\int_{-c} \frac{\tan z}{z^2-1}\,dz$ counter clockwise around c : $\lvert z\rvert = \frac{3}{2}$ using Cauchy's Residue theorem	7	APRIL 2018
8	Using contour integration evaluate $\int_{-\infty}^{\infty} \frac{x^2-x+2}{x^4+10x^2+9}\,dx$	7	JULY 2017
9	Evaluate $\int logzdz$ where C is the circle $\lvert z\rvert$ =1	7	MAY2019
10	Evaluate $\int 1/(5-3sin\theta)d\theta$	8	MAY2019
11	Find all singular points and residues of the functions (a) $f(z) = (z-\sin z)/z^2$ (b) f(z) =tanz	8	MAY2019
12	Evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+1)(x^{2+4})}dx$	8	MAY2019

Module V

1	Solve by Gauss elimination method: $X_1 - x_2 + x_3 = 0$ $-x_1 + x_2 - x_3 = 0$ $10x_2 + 25x_3 = 90$ $20x_1 + 10x_2 = 80$	5	MARCH2017
2	Find the rank of matrix $\begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & -4 \\ 0 & 4 & 0 \end{bmatrix}$ .Also find a basis for row space and column space	5	DEC 2016
3	Solve using Gauss elimination method: y+z-2w =0 2x-3y-3z+6w =2 4x+y+z-2w =4	6	MARCH2017
4	Reduce to echelon form and hence find the rank of the matrix $\begin{Vmatrix} 3 & 0 & 2 & 2 \\ -6 & 42 & 24 & 54 \\ 21 & -21 & 0 & -15 \end{Vmatrix}$	6	MARCH2017
5	Find the basis for the null space of $\begin{bmatrix} 2 & -2 & 0 \\ 0 & 4 & 8 \\ 2 & 0 & 4 \end{bmatrix}$	8	MARCH2017
6	Are the vectors (3,-1,4) (6,7,5) and (9,6,9) are linearly dependent or independent .Justify your answer.	5	MARCH2017
7	.Are all vectors (x,y,z) in R^3 with y -x+ z =0 form a vector space over the field of real numbers? Justify your answer.	5	MARCH2017
8	Solve using gauss elimination method: 3x+3y+2z=1,x+2y=4,10y+3z=-2,2x-3y-z=5	8	APRIL2018

9	Prove that the vectors (1,1,2),(1,2,5),(5,3,4) are linearly dependent	6	APRIL2018
10	Prove that the set of vectors V={(v_1,v_2,v3) ∈ℝ: -v_1+v_2+4v_3=0} a vector space over the field ℝ. Also find the dimension and the basis	6	APRIL2018
11	Find the values of a and b for which the system of linear equations $x + 2y + 3z = 6, + 3y + 5z = 9, 2x + 5y + az = b$ has (i) no solution (ii) a unique solution (iii) infinitely many solutions	7	MAY2019
12	Solve the system of equations by Gauss Elimination Method: $3x+3y+2z=1, x+2y=4, 10y+3z=-2, 2x-3y-z=5$	8	MAY2019

Module VI

1	Diagonalize the matrix A= $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$	10	DEC 2016
2	If 2 is an eigen value of $\begin{Vmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{Vmatrix}$ without using its characteristic equation ,find other eigen values .Also find the eigen values of A^3 ,A^T ,A^{-1} ,5A, A-3I and Adj A	7	JULY2017
3	What kind of conic section or pair of straight line is given by the quadratic form $3x^2+22xy+3y^2=0$ express $(x,y)^T$ in terms of new coordinates.	6	DEC 2016
4	Find out what type of conic section the quadratic form $Q=17x^2-30xy+17y^2=128$ represents and transform it to the principal axis	10	DEC 2016
5	Dioganalize the matrix A= $\begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{pmatrix}$ hence find A^4	8	MARCH2017
6	Determine whether the matrix is orthogonal $\begin{bmatrix} 1 & 0 & -0 \\ 1 & 1/\sqrt{2} & -1/\sqrt{2} \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix}$	5	DEC 2016
7	Find the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$	10	MARCH2017
8	What kind of conic section is given by the quadratic form $7{x_1}^2+6x_1x_2+7{x_2}^2=200$.Also find its equation	6	APRIL2018
9	Find the basis of null space of A= $\begin{bmatrix} 2 & -2 & 0 \\ 0 & 4 & 8 \\ 2 & 0 & 4 \end{bmatrix}$	6	MARCH2107
10	Reduce to echelon form and hence find the rank of the matrix A= $\begin{bmatrix} 3 & 0 & 2 \\ -6 & 42 & 24 \\ 21 & -21 & 0 \end{bmatrix}$	7	MARCH2107
11	Diagonalize the matrix $\begin{bmatrix} 3 & -1 & 1 \\ -1 & 3 & -1 \\ 1 & -1 & 3 \end{bmatrix}$	12	APRIL 2018
12	Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 1 & 4 \end{bmatrix}$	8	MODEL QUESTION