AKTC KALSEKAR TECHNICAL CAMPUS

INNOVATIVE TEACHING. EXUBERANT LEARNING

Knowledge Resource & Relay Centre (KRRC)

AIKTC/KRRC/SoET/ACKN/QUES/2018-19/   Date: _____

School: _SoET-CBCS_   Branch: __MECH. ENGG.__   SEM: ____VI____

To,
Exam Controller,
AIKTC, New Panvel.

Dear Sir/Madam,

Received with thanks the following **Semester/Unit Test-I/Unit Test-II (Reg./ATKT)** question papers from your exam cell:

Sr. No.	Subject Name	Subject Code	Format SC	Format HC	No. of Copies
1	Metrology & Quality Engg.	MEC601		✓	02
2	Machine Design – I	MEC602		✓	02
3	Finite Elements Analysis	MEC603		✓	02
4	Refrigeration and Air Conditioning	MEC604		✓	02
5	Department Level Optional Course II Mechatronics	MEC605		✓	02

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

MIT - sem-VI choice based - Mechanical
Paper / Subject Code: 111 / Metrology and Quality Engneering

10/5/1c

(3 Hours) [Total Marks: 80]

Instructions:

(1) Question No.1 is compulsory answer 3 Questions remaining 5 Questions.
(2) Assume suitable data wherever necary
(3) Concept explanation with suitable case study justification
(4) Diagram and sketches explanations right to reserve full marks

Q1 Answer **Any Four** Questions

    a) Write a short note on Nano metrology.   20

    b) Explain Eddy current testing methods.

    c) Write a note on CMM and of its types.

    d) Explain Surface irregularities with sketches measuring parameters R_a, R_z, R_y and RMS.

    e) What is Metrology? Explain different types of standards.

Q2

    a) Derive an expression for determination of effective diameter of threads by using 10
       two wire method.

    b) Define Interferometry. Explain Laser Interferometer with neat sketch. 10

Q3

    a) Explain the floating carriage micrometer with principle, construction, and 10
       measurement of threads.

    b) Explain Significance of QA & Quality Control in Industries with suitable 10
       examples.

Q4

    a) Explain the pneumatic comparator with principle, construction, and operation in 10
       detail.

    b) Explain various SQC Tools in quality engineering in detail. 10

Q5

    a) Calculate the limits, tolerance and allowances on a 25 mm shaft and hole pair 10
       designated H7/g6 to get a precision fit. The fundamental tolerance is calculated
       by the following equation:

$$i = 0.453\sqrt[3]{D} + 0.01D$$

       The following is given:

       (i) Upper deviation of shaft $= -2.5D^{0.34}$

       (ii) 25 mm falls in the diameter step of 18–30 mm

       (iii) $IT7 = 16i$

       (iv) $IT6 = 10i$

       (v) Wear allowance $= \frac{1}{10}$ of gauge tolerance.

    b) Explain the Parkinson Gear Tester with sketches in Gear profile checking process. 10

Q6 Answer any **Two** Questions   20

    a) Explain Autocollimator with sketches and its working principle in detail.

    b) What is acceptance sampling? Explain OC Curve in detail.

    c) Explain in detail - Design of GO and NO-GO gauges procedure with diagram.

Duration: 3Hrs   Marks:80

Instructions:
  i)   Question No.1 is compulsory
  ii)   Solve any three questions from the remaining
  iii) Assume suitable data wherever necessary
  iv)   Figure to the right indicates marks
  v)   Use of design data book is permitted

Q.1   **Solve any four questions from following**
  a)   Write the general procedure for designing any machine component.   **(05)**
  b)   What is the difference between endurance limit and fatigue strength of a   **(05)**
        material?
  c)   "Curved beams cannot be designed by applying the simple bending theory   **(05)**
        of straight beams" Justify the sentence.
  d)   Compare the weight, strength and stiffness of a hollow shaft of the same   **(05)**
        external diameter as that of solid shaft. The inside diameter of the hollow
        shaft being half the external diameter. Both the shafts have the same
        material and length.
  e)   Explain the surface finish factor and size factor with respect to machine **(05)**
        element subjected to variable load.

Q.2   a) Design a socket and spigot type of cotter joint to transmit reversible load **(14)**
          of 80 KN. Select suitable materials for various parts.
      b) Derive the Lame's equation for thick cylinder subjected to an internal   **(06)**
          pressure only.

Q.3   a) A shaft is supported in bearings A and B 1000 mm apart. An involute gear   **(12)**
          having PCD of 400 mm is located 300 mm to the right of LH bearing and
          600 mm diameter pulley is mounted 350 mm to the left of RH bearing.
          The gear is driven by a pinion located vertically above, while the pulley
          transmits power via belt to a pulley located vertically below. The ratio of
          belt tensions is 2. The pulley weigh 2500 N. Design the shaft, if power
          transmitted is 30 KW at 400 rpm. The shaft rotates clockwise when
          viewed from left side.
      b) A circular bar of 50 mm is weld to a steel plate by an annular fillet weld   **(08)**
          and is subjected to a twisting moment of 2 KN-m. If the allowable shear
          stress in the weld material is 85 MPa. Determine the size of the weld.

Q.4   a) Design a bush type of flexible coupling for connecting a reduction gear   **(14)**
          shaft to a stone crusher shaft. The unit is driven by 720 rpm motor
          through 5:1 reduction. Choose the type of coupling and write all the
          dimensions and design the shaft.
      b) Classify different engineering materials in details   **(06)**

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Q.5 a) A semielliptical leaf spring is used for the suspension of a rear axle of a (14) truck. It consists of two extra full length leaves and ten graduated leaves including master leaf. The centre to centre distance between the spring eyes is 1.2 m. The leaves are made of steel whose σ_{yt} is 1500 N/mm^2 and Young's modulus is 207000 N/mm2 and FOS is 2.5.

The spring is to be designed for maximum force of 30 KN. The leaves are prestress so as to equalize the stresses in all leaves. Determine cross section of leaves, the deflection at the end of spring and length of the all leaves by considering ineffective length 80 mm.

b) What is service factor? State its significance. (06)

Q.6 a) Design a bottle screw jack for lifting a load of 250 KN and having (14) maximum lift of 270 mm. Select proper material and draw a neat proportional sketch.

b) Explain fatigue test machine with neat sketch? (06)

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TE-Sem-VI-choice Based-Mech
22/5/19

Paper / Subject Code: 89023 / Finite Element Analysis

(3 Hours)   Max. Marks: 80

Note:
1. Question 1 is Compulsory
2. Solve any three from remaining five
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Q.1   Attempt any **four**   20
       a) Explain different types of Boundary conditions giving examples.
       b) Write element matrix equation in the following fields explaining each
          term:
          i.   1D steady state, heat transfer by conduction
          ii. Torsion Analysis
       c) Explain Subparametric, Isoparametric and Superparametric elements.
       d) Explain plane stress and plane strain conditions with examples.
       e) Explain the significance of shape functions.

Q.2   a) Solve the following differential equation using Method of least square   10
          and point Collocation method.
          (Assume collocation points $x = 0.25$ and 0.5)

          $$\frac{d^2\Phi}{dx^2} - \Phi = x; 0 \le \phi \le 1; \phi(0) = 0, \phi(1) = 0$$

          Compare answer with exact solution at $x = 0.5$

       b) A bar ABC shown in figure is subjected to a load
          of 60kN at B with a clearance of 1.5mm below   10
          the section at C. Area of AB is 150 mm^2 and
          length is 1.5m. Area of BC is 240 mm^2 and length
          is 3 m. Compute stresses in AB and BC. E=200
   GPa.
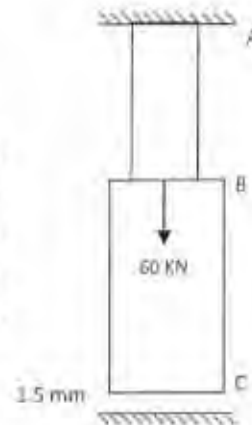
Q.3   a) Develop the Finite Element Equation for the most general element using   10
          Rayleigh Ritz method for a vertical bar with axial loading. The governing
          differential equation is

          $$\frac{d}{dx}\left(EA\frac{du}{dx}\right) + f = 0 \quad : \quad 0 \le x \le L$$

          where f is the weight of the bar per unit length.

       b) Derive the shape function for a rectangular element in local coordinate   10
          system and show its variation over the element.

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Q.4   a) Compute the stress developed in the members of the truss shown in   10
        figure. E=200 GPa. Area of the member AB is 20 cm^2 and its length is
        5m. Members BC and AC have the same area and is equal to 25 cm^2.
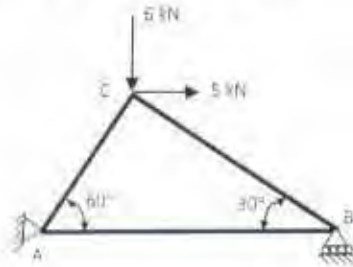
        b) What do you mean by consistent and lumped mass matrices? Derive the   10
   same for linear bar element.

Q.5   a) Evaluate the natural frequencies for the bar with varying cross sections   10
        shown in figure. $L = 200$ mm, $E = 200$ GPa and $\rho = 8000$ kg/m^3.
        Consider two elements of equal lengths.
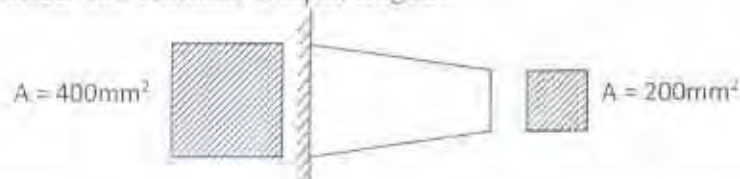
        b) A quadrilateral element is defined by the coordinates (1,4), (4,2), (5,6) and   10
        (2,7). The temperatures at the nodes are 20°C, 30°C, 40°C and 25°C
        respectively. Determine the temperature at a point which has local
        coordinates $\xi = 0.123$ and $\eta = -0.369$ and also its cartesian coordinates.

Q.6   a) A triangular plate of size 75mm x 50 mm x 12.5 mm is as shown in figure.   12
        The modulus of elasticity and Poisson's ratio for plate material are 200 x
        10^3 N/mm^2 and 0.25 respectively. Upon loading of the plate, the nodal
        deflections at node 3 were found to be 0.01552mm and -0.0004 mm in x
        and y direction respectively. Model the plate with CST element and
        determine :
        i)   The Jacobian for (x,y)-(ξ,η) transformation
        ii)   The strain-displacement relation matrix
        iii)   The stress in plate
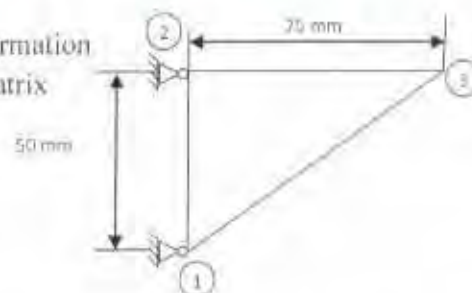
        b) Explain Convergence criteria. What do you understand by h & p method
        of Finite Element Analysis?   08

(3 Hours) [Total Marks 80]

Note:1) Question no. 1 is compulsory.
2) Attempt any **three** questions out of the remaining **five** questions.
3) Clearly mention the assumptions made if any.
4) Use of Refrigerant Tables, P-h chart, Friction chart, Psychrometric Chart and Steam table is permitted.

Q.1 Answer any **Four** of the following: 20

a) List down the types of aircraft air cooling systems. Draw T-s Diagram for Simple Air Evaporative Cooling System
b) Draw VCR Cycle on P- h diagram with sub-cooling of liquid refrigerant in condenser & explain the processes involved in the cycle.
c) What is Bypass factor? Explain it for heating and cooling coil.
d) Define & explain RSHF, GHSF and ERSHF.
e) What is Human Comfort? Explain with the help of ASHRAE Comfort Chart.
f) In a refrigeration plant working on Bell-Coleman cycle, air is compressed to 5 bar from 1 bar. Its initial temperature is 10°C. After compression, the air is cooled upto 20°C in a cooler before expanding back to a pressure of 1 bar. Determine Theoretical COP & Net Refrigeration Effect of the plant. Take $\gamma = 1.4$ for air.

Q.2 a) The following data refers to Simple Air Refrigeration Cycle of 20TR capacity.
Ambient air temperature & pressure = 20°C & 0.8 bar
Ram air pressure = 0.9 bar
Compressor outlet pressure = 3.6 bar
Temperature of air leaving H.E. = 60°C
Pressure of air leaving the turbine = 1 bar
Temperature of air leaving the cabin = 27°C
Compressor & Turbine efficiency = 80% & 75% respectively
Assume no pressure drop in H.E. & isentropic ramming process. Calculate;
    (i)   Mass of air circulated per minute.
    (ii)   Power required.
    (iii) COP. 12

b) Classify Ducts & derive an expression for an equivalent diameter of a circular duct for rectangular duct for same frictional loss per unit length when quantity of air flowing through both ducts is same. 08

Q.3 a) A Vapour Compression Refrigeration System using NH₃ works between -15°C and 40°C as evaporator and condenser temperature respectively. The vapour is superheated by 5°C before entering compressor & liquid is sub-cooled by 5°C before leaving the condenser. Using P-h chart, determine;
(i)   COP
(ii) Mass of Refrigerant per TR
(iii) Piston Displacement per TR using Volumetric efficiency = 80%
(iv) Heat rejected in the condenser per TR
(v) Ideal COP 12

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b) Explain Sensible Heating, Sensible Cooling, Humidification and Dehumidification process. 04

c) Classify Cooling Towers & explain its application. Define Range & Approach. 04

Q.4 a) The specific humidity of atmospheric air at 28°C DBT and barometric pressure of 760 mm of Hg is 0.016 Kg/Kg of dry air. Determine the following without using Psychrometric chart:
   (i) Partial pressure of water vapour.
   (ii) Relative Humidity.
   (iii) Dew Point Temperature.
   (iv) Specific Enthalpy. 08

b) Derive an expression for COP of an Ideal Vapour Absorption Refrigeration System. 06

c) Describe various psychrometric processes in an Air washer. 06

Q.5 a) The following data is given for Summer air conditioning of a building:
   Outside design conditions = 43°C DBT, 27°C WBT
   Inside design conditions = 25°C DBT, 50%RH
   Room Sensible Heat Gain = 84,000 kJ/hr
   Room Latent Heat Gain = 21,000 kJ/hr
   By-Pass Factor of cooling coil = 0.2
   The return air from the room is mixed with the outside air before entering the cooling coil in the ratio
   of 4:1 by mass. Determine:
   (i) Apparatus Dew Point of the cooling coil.
   (ii) Inlet & Outlet conditions of air for cooling coil.
   (iii) Fresh air mass flow rate.
   (iv) Refrigeration load on the cooling coil in TR. 14

b) Classify Refrigerants with example of each type. Which refrigerants are considered environment friendly? Explain. 06

Q.6) Write short note on any **Four** of the following: 20
   a) BEE Star Rating System.
   b) Types of Compressors & Expansion Devices.
   c) Thermoelectric Refrigeration.
   d) Green Buildings.
   e) Vortex Tube Refrigeration.
   f) Deep Sea Water Air Conditioning.

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TE-sem-$\overline{VI}$ - choice Based - Mech

3/6/19

(03 Hours)   [Total Marks 80]

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q1 a. Write short note on PLC Architecture.   8

   b. With a neat block diagram explain key elements of a mechatronic system with   6
       example.

   c. What is proportional-integral-differential (PID) controller? Explain role of each of   6
       the constituents with neat sketch.

Q2 a. Draw the root-locus of the control system whose open-loop transfer function is given   10
       by

$$G(S)H(S) = \frac{K(S+2)}{S(S+5)(S+8)}$$

       Comment on the stability of system.

   b. Reduce the following block diagram to canonical from   6
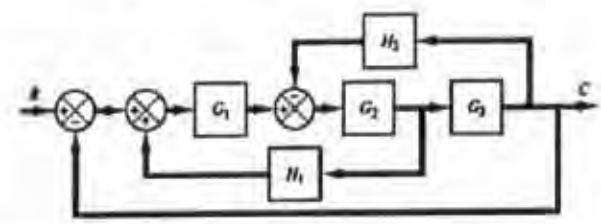
   c. Explain working principle of solenoid actuators.   4

Q3 a. Two double acting pneumatic cylinders A, B are selected for an industrial   10
       application. The sequence of movement for piston of the cylinder is proposed as
       below—

                           Delay A+ B+ (AB) -

       Develop the electro hydraulic circuit using 4/2 double solenoid as final directional
       control valves. The piston motions mentioned in bracket is simultaneous. Also Draw
       time - displacement diagram.

   b. Explain the types of temperature sensor, also select the sensor based on the   5
       parameters (a) Accuracy (b) Sensitivity.

   c. Write note on R-2R circuit.   5

Q4 a. A process control system illustrated in figure 1 is desired to fill the bottle and convey this. The outlet valve is opened to fill the bottle as when the limit switch senses the presence of bottle and is closed automatically when the photo sensor produces the signal as when the bottle is filled. The level of water in tank is maintained through a control valve. Develop a PLC ladder logic diagram for this control application. **10**
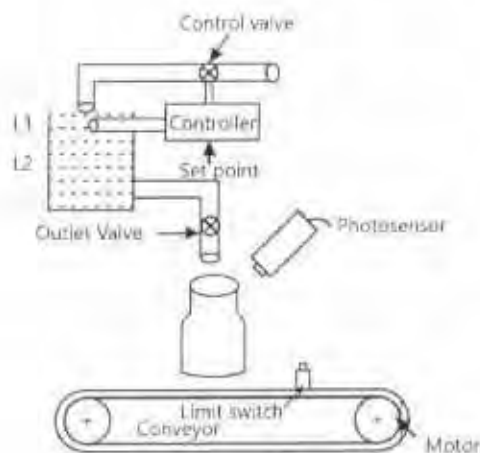

Figure 1

b. Explain with neat sketch working principle of DC motor. **5**

c. With neat diagrams illustrate the working of Filter-Regulator-Lubricator (FRL) unit in a pneumatic system. **5**

Q5 a. For an open loop transfer function with a unity feedback system **10**

$$G(s) = \frac{4}{S(S+1)}$$

Determine characteristic equation and hence calculate damping ratio, natural frequency, raise time, Peak time, settling time, peak overshoot.

b. Explain Signal Filters – Low pass, High Pass and Band Pass with circuit diagrams in detail. **10**

Q6 Write short note on (5 marks each) **20**
a. Servo Mechanism in Servo motors.
b. Meter in & Meter out circuit with application.
c. Mechatronics & its applications in domestic, industrial one example each.
d. R-2R circuit .