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

School: SoET-CBSGS **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		No. of Copies
			SC	HC	
1	Metrology & Quality Engg.	MEC601		✓	02
2	Machine Design – I	MEC602		✓	02
3	Mechanical Vibration	MEC603		✓	02
4	Thermal & Fluid Power Engg.	MEC604		✓	02
5	Mechatronics	MEC605		✓	02
6	Finite Elements Analysis	MEC606		✓	02

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

TE - sem-V) - CBSGS - [redacted]

Paper / Subject Code: 37501 / METROLOGY AND QUALITY ENGINEERING 10/5/1

Q.P. Code: [redacted]

Total Marks: 80 **Duration: 3 Hours**

N.B.:-

1. Question No.1 is compulsory
2. Solve any three out of remaining questions
3. Assume suitable data if required and mention it clearly
4. Figures to right indicate full marks

Q1 A] Explain different types of tolerance grades 5
B] Write short note on-Planning for quality. 5
C] Explain principle of interference. 5
D] Explain importance of surface conditions. 5

Q2 A] Explain following:- 10
1) Plug gauges and ring gauges
2) Filler gauges
B] Explain following parameters with respect to surface [redacted]ness measurement:- 10
1) R_a Value
2) R_z Value
3) R_y Value
4) Roughness and Waviness

Q3 A] Explain Construction and working of Pneumatic Comp[redacted]ors. State their advanta[redacted] and limitations. 10
B] How will you set up policy and objectives of quality c[redacted]l? Explain concept of q[redacted] of design. 10

Q4 A] Explain construction and working of Tool makers mic[redacted]pe with the help of sui[redacted] sketch. 10
B] Explain following:- 10
1) Scatter diagrams
2) Pareto Charts

Q5 A] Explain construction and working of Profile Projector[redacted] various applications o[redacted] Profile projector 10
B] Explain following:- 10
1) X bar Charts
2) R Charts
3) P Charts
4) Np Charts

Q6 A] Explain Principle, Construction and working of Parkin[redacted]'s Gear tester 10
B] Sketch OC curve and explain various elements of it. A[redacted]xplain double sampling plans 10

TE Sem-VI - Mech-CBSGS

16/5/19

Paper / Subject Code: 37502 / MACHINE DESIGN - I

Q.P. Code: 25531

Time: 3 Hours **Marks: 80**

- Question No. 1 is compulsory.
- Attempt any three questions from the remaining.
- Assumption made should be clearly stated.
- Use of standard Design Data Book by PSG, Mahadevan is permitted.

Q.1 Answer any **four** of the following **20**

(a) What is preferred Number? How to use it, explain with example.

(b) Draw and explain different fatigue stress cycle.

(c) Explain overhauling of screw and self-locking of screw.

(d) Describe any two methods to reduce the stress-concentration effect with the help of neat sketches.

(e) What is the necessity of theories of failures? Discuss different theories of failures.

Q.2 (a) Why the cotter in the Cotter joint is kept as weakest part, explain. **4**

(b) A knuckle joint is to be design to connect two Mild Steel bars under a tensile load of 150 KN. The allowable stresses are 75Mpa in tension, 50Mpa in shear and 150 Mpa in crushing. (Assume empirical relations as Diameter of knuckle pin $d_1 = d$, Outer diameter of eye $d_2 = 2d$, diameter of knuckle pin head and collar $d_3 = 1.5d$, thickness of single eye $t = 1.25d$, thickness of fork $t_1 = 0.75d$, thickness of pin head $t_2 = 0.5d$)

1. Draw neat sketch of knuckle joint. **3**
2. Find the diameter of the rod (d). **2**
3. Using empirical find all dimensions. **3**
4. With neat sketches for failure cross section areas check all components under different failures. **8**

Q.3 (a) Show the variation of the tangential stress and radial stress across the cylinder thickness and derive the Lame's equation for the thickness of thick cylinder subjected to an internal pressure only. **4**

(b) A transmission shaft supporting a spur gear B and pulley D is shown in Figure 1. The shaft is mounted on two bearings A and C. The diameter of pulley and the pitch circle diameter of the gear are 400 mm and 300 mm respectively. The pulley transmits 15 kW power at 550 rpm to the gear. P_1 and P_2 are belt tensions in tight and loose sides, while P_t and P_r are tangential and radial components of gear tooth force. **16**

Assume $P_1 = 3P_2$ and $P_r = P_t \tan(20^0)$

The gear and pulley are keyed to the shaft. The material of the shaft is steel 50C4

(σ_{ut} =700 N/mm^2 and σ_{yt} = 460 N/mm^2, $[\tau]$ = 80 N/mm^2). The factors k_b and k_t are 1.25 each. Determine the shaft diameter.

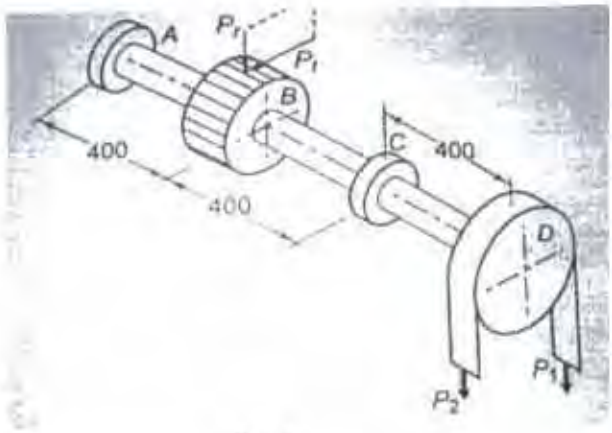

Fig.1

Q.4 (a) Design a cast iron protective type flange coupling to transmit 15 kW at 900 rpm from an electric motor to compressor. The service factor may be assumed as 1.35. The following permissible stresses may be taken. Allowable shear stress for shaft, bolt and key material is 40MPa, Allowable crushing stress for bolt and key is 80 N/mm^2 and Allowable shear stress for cast iron is 8 N/mm^2. **12**

(b) Design a Helical valve spring for an operating load range of 600N to 1200N. The compression at the maximum load is 25mm. Take the spring index 6 and permissible shear stress for the spring material as 480Mpa and yield stress is 960MPa. Assume G = 80KN/mm^2. **08**

Q.5 (a) Draw neat sketch for the fatigue test set up. How the experimental data is generated and analyzed, explain. **10**

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(b) The circular rod is subjected to 700KN tensile to 300KN compressive varying axial load. Find the diameter of the rod using soderberg criteria and assuming following data. Endurance limit = 280Mpa, tensile yield strength =350Mpa, factor of safety =2, correction factor for loading = 0.7, surface factor = 0.8, size factor = 0.85, stress concentration factor = 1. **10**

Q.6 (a) Select suitable standard hook for the lifting load of 100KN of trapezoidal cross section and find the stress induced at the most critical cross section of the hook. **10**

(b) A bracket is supported by four rivet of equal diameter as shown in figure 2, to support a load of 20KN. Determine the size of the rivet, taking the permissible shear stress as 60MPa. **10**

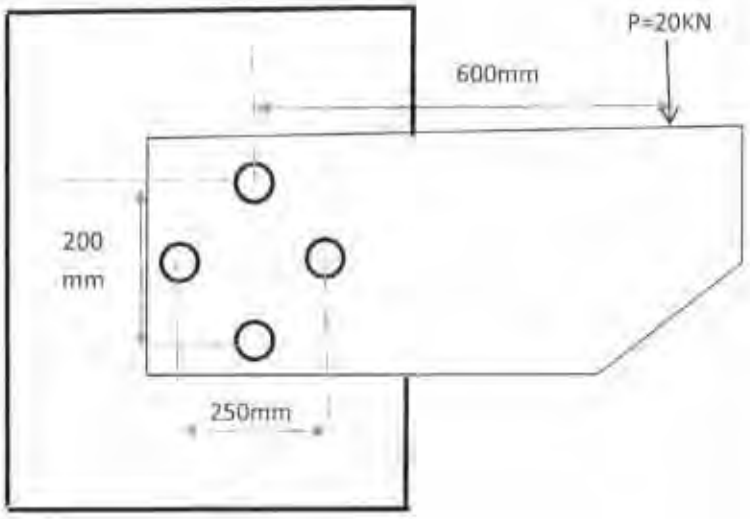

Fig. 2

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(43)

TE-sem-VI - CBSGS - Mech

Paper / Subject Code: 37503 / MECHANICAL VIBRATIONS

22/5/19

Q. P. Code: 38428

(3 Hours) [Total Marks: 80]

N.B. 1) Question No. 1 is **compulsory**

2) Answer any **Three** questions from remaining **Five**

3) Assume suitable data wherever required, justify the same

4) Answer to questions showed be grouped and written together.

1 Solve **any Four** 20

a A spring mass system has natural frequency of 12 Hz. When the spring constant is reduced by 800 N/m, the frequency is changed by 50%. Determine the mass and spring constant of original system

b A 5 kg mass attached to the lower end of a spring, whose upper end is fixed, vibrates with a natural period of 0.45 sec. determine the natural period when a 2.5 kg mass is attached to the mid-point of the same spring with the upper and lower end fixed.

c Prove that the loss of amplitude per cycle = 4F/k, in case of coulomb damping. Where F – friction force, k – spring stiffness.

d Discuss how a single revolving mass is balanced by two masses revolving in different planes.

e A single DOF system consists of a mass of 20 kg and a spring stiffness 4000 N/m. the amplitude of successive cycles are found to be 50, 45, 40, 35 .....mm. determine the nature and magnitude of the damping force and frequency of damped vibrations.

2 a A 2.5kg slender bar of length 40 cm is pinned at one end. A 3 kg particle is to be attached to the bar. How far from the pin support should the particle be placed such that period of bar's oscillation is 1 sec.? 10

b A door 200 cm high, 75 cm wide and 4 cm thick and weighing 35 kg is fitted with an automatic door closer. The door opens against a spring with a modulus of 1 kg-cm/radian. If the door is opened 90^0 and released, how long will it take the door to be within 1^0 of closing? Assume the return spring of the door to be critically damped. 10

3 a A thin disk of mass 0.8 kg and radius 60 mm is attached to the end of a 1.2 m steel (G= 80×10^9 N/m^2, ρ = 7500 kg/m^3) shaft diameter 20 mm. the disk is subjected to harmonic torque of amplitude 12.5 N-m at a frequency of 700 rad/s. what is the steady state amplitude of angular oscillations of the disk? 12

b A seismic instrument is mounted on a machine running at 1000 rpm. The natural frequency of the seismic instrument is 20 rad/sec. the instrument records relative amplitude of 0.5 mm. Compute the displacement, velocity and acceleration of machine. Damping in seismic instrument is neglected. 08

4 a A radio set of 20 kg mass must be isolated from a machine vibrating with amplitude of 0.05 mm at 500 rpm. The set is mounted on four isolators, each having a spring scale of 31,400 N/m and damping coefficient 392 N sec/m. 10

i) What is the amplitude of vibration of the radio?

ii) What is the dynamic load on each isolator due to vibration?

b A steel shaft of diameter 10 cm is carrying three masses 2.5 kg, 3.75 kg and 7 kg respectively as shown in Fig. 1. The distance between the rotors is 0.7 m. determine the natural frequencies of torsional vibrations. The radii of gyration of three rotors are 0.20, 0.30 and 0.40m respectively. Take G = 9×10^8 N/m^2. 10

Q. P. Code: 38428

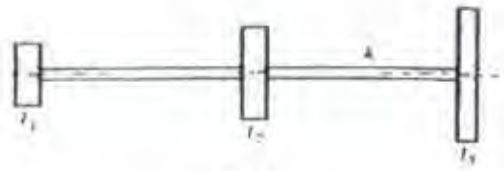

Fig. 1

5 a Determine the natural frequency of vibration for a system in Fig. 2. Take mass of the beam as 5 kg. 08

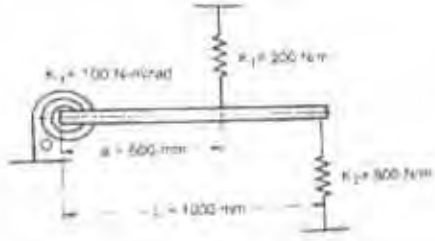

Fig. 2

b Fig.3 Shows the arrangement of the cranks in a four crank symmetrical engine in which the masses of the reciprocating parts at cranks 1 and 4 are each equal to m_1 and at cranks 2 and 3 are each equal to m_2. 12

Show that the arrangement is balanced for primary forces and couples and for secondary forces provided for that

$\frac{m_1}{m_2} = \frac{\cos\theta_2}{\cos\theta_1}$; $\frac{a_1}{a_2} = \frac{\tan\theta_2}{\tan\theta_1}$, and $\cos\theta_1 \times \cos\theta_2 = \frac{1}{2}$

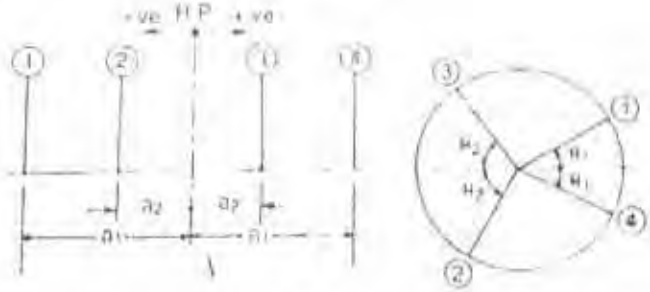

Fig. 3

6 a A centrifugal blower rotating at 400 rpm is driven by an electric motor running at 1200 rpm through a single stage reduction gear. Moments of inertia of the blower rotor and the motor are 1500 kg-m^2 and 450 kg-m^2 respectively. Lengths of the rotor shaft and motor shaft are 500 mm and 200 mm respectively and their diameters are 100 mm and 50 mm respectively. Neglecting inertia of the gears, find the frequency of torsional vibrations of the system. Take G = 85 x 10^9 N/m^2. 12

b A spring mass system with mass m kg and stiffness k N/m has a natural frequency of f Hz. Determine the value of the stiffness k' of another spring which when arranged in conjunction with spring of stiffness k in series will lower the natural frequency by 20% and in parallel will raise the natural frequency by 20%. 08

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Q.P.Code: 21485

(3 Hours) [Total Marks: 80

Note:
1. Question No.1 is compulsory.
2. Attempt any three questions from remaining.
3. Steam table is permitted.
4. Assume suitable data if required.

Q.1 Solve any five (20)

a. Differentiate Steam turbine and Hydraulic turbine.
b. What is Cavitation? How it can be avoided?
c. Differentiate between jet engine and rocket engine.
d. Describe working actual Brayton cycle? State the assumptions clearly.
e. State the role of Injector, Super heater, fusible plug and steam stop valve in Boiler.
f. What is degree of reaction? Prove that the degree of reaction for parson's reaction turbine is 50%.

Q.2 a) Explain the construction and working of Velox boiler. (10)

b) Calculate throat diameter and exit diameter of a converging-diverging nozzle for following data: (10)

Initial steam pressure = 13 bar
Final steam pressure = 4 bar
Quantity of steam = 1.2 kg/s
Steam temperature at inlet = 300°C
nozzle efficiency = 0.86

Q.3 a) Calculate equivalent evaporation and efficiency of the boiler for the following data: Pressure of steam = 9 bar, Quality of steam = 0.97 dry, Quantity of steam = 5600 kg/hr, Temperature of feed water = 36°C, Coal consumption = 700 kg/hr, C.V. of coal = 31380 kJ/kg of fuel. What will be the saving in coal consumption per hour if by putting an economizer the temperature of feed water is raised to 100°C and other data remains same except the increase in boiler efficiency by 5 %. (10)

b) A Pelton wheel is to be designed for the following specifications: (10)

Power (Brake or Shaft) = 9560 kW; Head = 350 m; Speed = 750 rpm; Overall efficiency = 85%; Jet diameter is limited to 1/6th of the wheel diameter. Determine the wheel diameter, diameter of jet and number of jet required. Take C_v = 0.985 and speed ratio =0.45.

Q.4 a) In a De-Laval turbine, steam issues from the nozzle with a velocity of 850m/s. The nozzle angle is 20^0. Mean blade velocity is 350 m/s and the blades are equiangular. The mass flow rate is 1000 kg/min. The friction factor is 0.8. Determine blade angles, axial trust on the bearings, power developed in kW, blade efficiency, stage efficiency if nozzle efficiency is 93%. (10)

b) Derive an expression for maximum hydraulic efficiency of a Pelton wheel with neat sketch. State assumptions clearly. (10)

Q.5 a) An inward flow reaction turbine is supplied 0.233 m^3/s of water under a head of 11 m. The wheel vanes are radial at inlet and the inlet diameter is twice the outlet diameter. The velocity of flow is constant and equal to 1.83 m/s. The wheel makes 370 r.p.m. Determine guide vane angle, inlet and outlet diameter of wheel and width of wheel at inlet and exit. Assume that the discharge is radial and there are no losses in wheel. Take speed ratio = 0.7. Neglect the thickness of the vane. (10)

b) A gas turbine installation works on Brayton cycle between the temperature limits of 35^0C and 715^0C. For the maximum work developed calculate temperature at the end of compression, pressure ratio and thermal efficiency. (10)

Q.6 Solve any four (20)

a. Differentiate Francis and Kaplan Turbine
b. Explain the working of Ramjet Engine?
c. Write the features of High Pressure boiler in comparison to low pressure boiler.
d. Describe working of reheating gas turbine plant with the help of a T-S diagram.
g. Why compounding is necessary? Explain working of pressure-velocity compounding with neat sketch.

(12) TE-sem-VI-CBSGS-Mech 3/6/19

Paper / Subject Code: 37505 / MECHATRONICS

(3 Hours) **[Total marks: 80]**

Instructions:
1. **Question 1 compulsory**
2. Attempt any **three** questions from the remaining **five** questions.
3. Assume suitable data, **if necessary**.
4. **Figures/sketches** carry weightage.

Q1) Explain the following [Any four] **20**
1) Components of Mechatronics
2) Autonomous Robot
3) Parameters to be considered for selection of an actuator
4) Servo Amplifier
5) Buffers

Q2) a) Explain the concept of Handshaking, Polling and Interrupt **07**

b) Explain harmonic drive with a neat sketch **07**

c) Explain the optimization of velocity profile optimization in DC motors **06**

Q3) a) Explain the following **10**
i) Inertia Matching ii) Accumulator

b) Two double acting pneumatic cylinders are selected for an industrial application ;The sequence of the movement is as given below:- **10**
$(AB)^{*}$ A+B+
Draw a pneumatic circuit

Q4) a) Explain SCADA with a neat sketch **07**

b) Mechatronics used in Office application with a neat block diagram **07**

c) Explain selection process of PLC **06**

Q5) a) Two double acting pneumatic cylinders are selected for an industrial application ;The sequence of the movement is as given below:- **10**
A +, B-, Delay (A-B+) Delay, B-Delay.
Draw electro pneumatic circuit using 4/2 DC valve which is single solenoid and spring operated using single cycle operation and also sketch the displacement diagram

b) With a neat sketch explain the constructional features, working and application of a Voice Coil Actuator. **10**

Q6) a) Explain the constructional features and working of an Engine Management system with a neat sketch **10**

b) Explain the following: **10**
i)Universal Asynchronous Receiver and Transmitter ii) Key elements of mechatronics

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(13)

TE - sem- VI - CBSGS - May

10/6/19

Paper / Subject Code: 37506 / FINITE ELEMENT ANALYSIS

(3 Hours) Max. Marks: 80

Note:

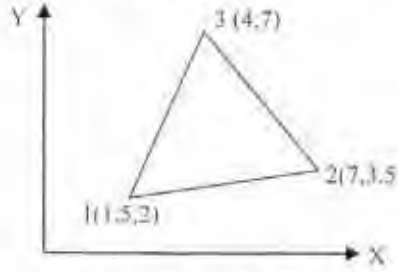
1. Question 1 is Compulsory
2. Solve any three from the remaining five questions
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Question No.		Max. Marks
Q.1	Attempt any **four**	20
	a) Explain the importance of node numbering with example in FEA.	
	b) What is convergence and state the conditions to achieve it.	
	c) State and explain the principle of minimum potential energy	
	d) Explain terms i) Plane stress ii) Plane strain iii) DOF iv) Element v) Node	
	e) Explain with example the types of boundary conditions used in FEA.	
Q.2	a) Solve the Differential Equation using Galerkin method and Least square Method. Also compare the results with classical method at x=0.5.	12

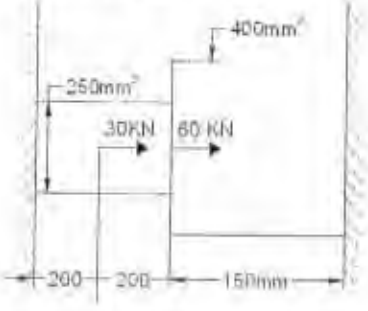
$$-\frac{d^2u}{dx^2} + u + x = 0 \; ; \; 0<x<1$$

Given Boundary Conditions are: $u(0) = (du/dx)(1) = 0$

b) Evaluate the shape function at the nodes and prove its property, for triangular element as shown in figure. 08



Q.3	a) Consider the Bar shown in Fig. Determine the Nodal Displacement, Element Stress and Reactions if the Temperature is increased by 60°C. Assume Modulus of Elasticity for the complete Bar as 200 GPa & Coefficient of Thermal expression as 12×10^{-6} per °C.	10



b) What is serendipity element?. Derive the shape function for eight noded rectangular element. 10

Q.4 a) A constant strain triangle element has the nodal coordinates (15,-8), (10,5) and (2,0) mm for i , j & k nodes respectively. The element is 2 mm thick and is of material with properties E=70GPa and Poisson's ratio 0.3. Upon loading of the model, the nodal deflections were found to be: 12

$u_i = 100\mu m$	$u_j = 75\mu m$	$u_k = 80\mu m$
$v_i = -50\mu m$	$v_j = -40\mu m$	$v_k = -45\mu m$

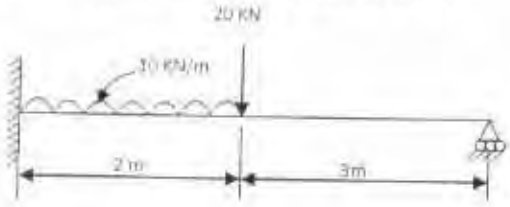
Determine-

1. The Jacobian for (x,y)-(ξ,η) transformation
2. The strain-displacement relation matrix
3. The strains
4. The element stresses.

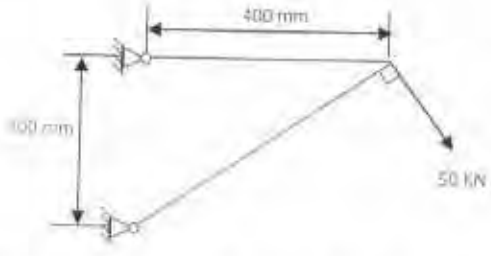
b) Differentiate between lower and higher order element. Derive shape function for linear cubic element by using Lagrange's interpolation function 08

Q.5 a) Find the natural frequency of axial vibrations of a bar of uniform cross section of 30×10^{-4} m^2, length 1m with left end fixed. Take E = 2×10^{11} N/m^2 and ρ = 7800 kg/m^3. Take two linear elements. 10

b) Find using FEA the deflection and slopes at nodes and reactions at supports for the beam as shown in figure. Take EI = 5000 KN-m^2. 10



Q.6 a) Analyze the following Truss completely for reactions, stress and strains. Area of c/s = 200 mm^2 and E = 180 GPa. 10



b) Develop the Finite Element Equation for the most general element using Rayleigh Ritz method for the mathematical model given 10

$$\frac{d}{dx}\left(AE\frac{du}{dx}\right) = 0 \text{ for } 0 < x < 12 \text{ cms}$$

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