AUTO / AS / CBGS / TE VI / May 2017

Q.P. Code : 13449

16/05/17

Time : 3 Hours **Total Marks: 80**

N.B: (1) **Question** no **1** is compulsory.

(2) Attempt **any three** out of remaining **five** questions.

(3) Draw neat and labelled diagrams wherever necessary.

Q.1 Answer the following questions:

a) Explain clearly how it is made sure in a gearbox that at a time no two gears are engaged simultaneously. Illustrate your answer with neat sketch. 05

b) Describe the necessity of gearbox at all in automobile when the engine speed can be varied by means of accelerator pedal? 05

c) What are components of Drive lines? Sketch and explain the working of Universal Joint and Constant Velocity Joints. 05

d) Explain Worm and wheel type of steering gear box with neat diagram. 05

Q.2 a Describe the construction and working of Synchromesh gear box. Show how power flows at various speeds. 10

b Explain fluid flywheel/coupling & Torque converter with respect to working construction and application along with neat diagram. 10

Q.3 a Sketch and explain working of Final Drive gears and bearings. 10

b Explain Rear Axle drives in brief with neat diagrams. 10

Q.4 a Explain minimum 5 terms related to Front end/Steering Geometry with neat diagram for each. 10

b Explain need of differential in automobiles. Also explain working of simple open differential with neat labelled diagram. 10

Q.5 a Sketch and explain working of Transfer case and Transaxle. 10

b Explain hydraulic brake system and Endurance brake system with neat and labelled diagram. 10

Q.6 Write short note on :

a) Mc pherson strut type suspension. 05

b) Radial and Cross ply type tire construction 05

c) Types of Rear Axle casings. 05

d) Over drive and Tandem axle drives. 05

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AUTO/ Sem VI / CBSGS / MN/ 26-5-17

T0526 / T0846 MECHANICAL VIBRATIONS

Q. P. Code: 17183

Con. (REVISED COURSE)

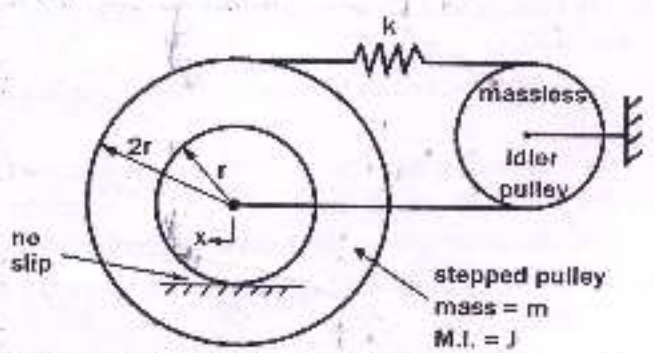
[Total Marks : 80

(3 Hours)

N.B : 1. Question No.1 is **compulsory.**
2. Attempt **any three** from the remaining five questions.
3. **Assume suitable data wherever required** with proper justification.

1. Attempt **any four** of the following. **All sub-questions carry equal marks.** 20
   (a) Derive the differential equation for a simple harmonic motion. Hence, represent displacement, velocity and acceleration in the form of rotating vectors. Indicate clearly the magnitude of the vectors and the relative phase differences.
   (b) A spring of mass m_s and stiffness k fixed at one end is connected to a lumped mass m. The spring is inclined to the direction of movement of mass by an angle α. Find the time period of vibration of the system, for small amplitudes.
   (c) A semi-definite system consists of 2 lumped masses 1 kg each and a helical spring of stiffness 50 N/m connecting them. Estimate the values of the natural frequencies in rad/s, and draw the corresponding mode shapes. Find the position of the nodes, if any.
   (d) How does the force transmitted to the base change as the speed of the machine increases? Explain using an equation and the corresponding graph.
   (e) Stating the formula, sketch the dimensionless amplitude versus frequency curves of a vibration measuring instrument. Explain in what regions it can be used as an accelerometer and as a vibrometer.
   (f) Two identical discs are connected by four bolts of different sizes and mounted on a shaft. The masses and locations of three bolts are as follows—m_1 = 35 gm, r_1 = 110 mm, and Θ_1 = 40°; m_2 = 15 gm, r_2 = 90 mm, and Θ_2 = 220°; and m_3 = 25 gm, r_3 = 130 mm, and Θ_3 = 290°. Find the mass and location of the fourth bolt (m_4, r_4 and Θ_4) which results in the static balance of the discs.

2. (a) Considering generalized coordinate x, evaluate the time period of vibration for the system shown below. 10



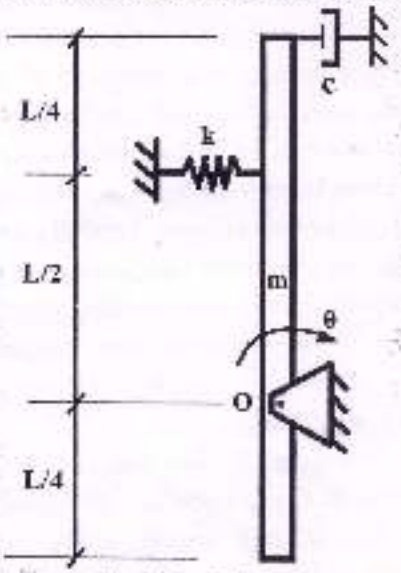
   (b) A machine part weighing 5 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic force of 36 N results in 15 mm resonant amplitude with a period of 0.32 s. 10

Turn Over

3. (a) In a simple spring-mass-damper system, the mass is 20 kg, spring constant is 10 kg/cm, and the damping coefficient has a value of 0.15 kg-s/cm, and the system is initially at rest. When a velocity of 10 cm/s is given to it, determine the displacement and velocity of the mass after 1 second. 10

(b) A spring-mass system, having a static deflection of 10 mm and negligible damping, is used as a vibrometer. When mounted on a machine operating at 4000 rpm, the relative amplitude is recorded as 1 mm. Find the maximum values of displacement, velocity, and acceleration of the machine. 10

4. (a) Figure below shows an inverted pendulum connected to a spring and viscous damper. Assuming that the inverted pendulum is in stable equilibrium while in motion, derive the equivalent system parameters for small angular oscillation Θ. 8

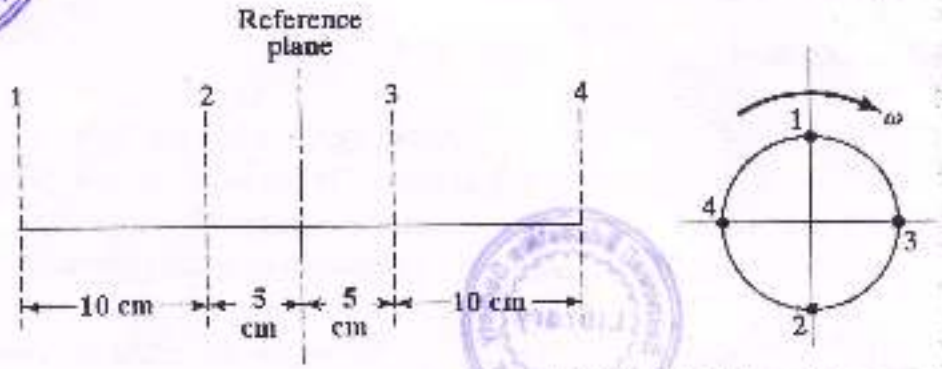


(b) Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 195° respectively with that of mass B in the counter-clockwise direction. The rotating masses have following properties—m_B = 25 kg, m_C = 40 kg, m_D = 35 kg, r_A = 150 mm, r_B = 200 mm, r_C = 100 mm, r_D = 180 mm. Planes B and C are 250 mm apart. Determine—(i) the mass A and its angular position w.r.t. mass B (ii) the positions of all the planes relative to plane of mass A. 8

(c) Compare Dunkerley's and Rayleigh's methods for analyzing beam vibrations. 4

5. (a) A four cylinder in-line engine has a reciprocating mass of 1.6 kg, a stroke of 15 cm, and a connecting rod length of 25 cm in each cylinder. The cranks are separated by 10 cm axially and 90° radially, as shown in the following figure. Find the unbalanced primary and secondary forces and couples with respect to the reference plane shown in figure, at an engine speed of 1500 r.p.m. 10

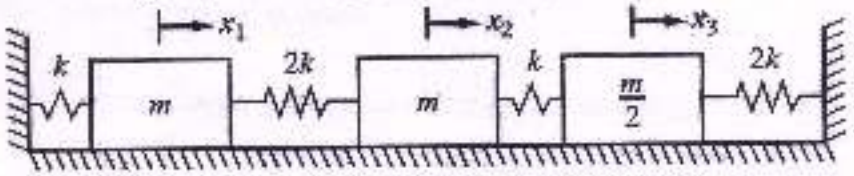
Turn Over



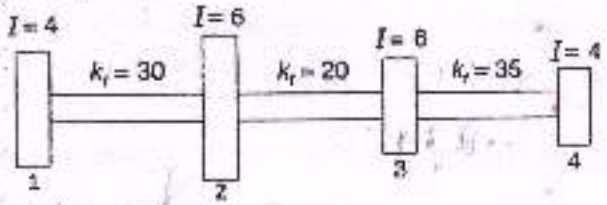
(b) When a washing machine, of mass 200 kg and an unbalance 0.02 kg-m, is mounted on an isolator, the isolator deflects by 5 mm under the static load. Find (i) the amplitude of the washing machine, and (ii) the force transmitted to the foundation at the operating speed of 1200 rpm. 10

6. (a) What are the steps followed in the vibration analysis? Briefly explain. 5

(b) Using exact analysis, calculate the natural frequencies and draw the corresponding mode shapes for the three degree of freedom system as shown below. 10



(c) For the torsional multi-degree of freedom semi-definite system shown below, investigate whether $\omega = 1.78$ rad/s (approximately) is one of the natural frequencies, or not. Also, state the value of the fundamental frequency. Use Holzer's method. Here, I is expressed in kg-m² and k_t is expressed in Nm/rad. 5



AUTO/ C-BS&S/ TE Sem VI / TEFP / 02/06/19

T0526/T0847 THERMAL AND FLUID POWER ENGINEERING

Q. P. Code: 18032

3 Hours 80 Marks

NOTE:

- Question No 1 is **COMPULSORY**.
- Attempt any **THREE** questions from question number 2 to 6.
- Assume suitable data wherever required.
- Illustrate answers with sketches wherever required.
- Use of steam table is permitted.

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1. Solve the following **(any Five)** 20

   (a) Explain nozzle efficiency with the help of h-s diagram.

   (b) Write applications of gas turbine.

   (c) Differentiate between impulse and reaction type steam turbines.

   (d) State the purpose of draft tube incase of water turbine.

   (e) Write the detail classification of jet propulsion engine.

   (f) Define unit speed and specific speed.

2. (a) What are the different methods used to improve efficiency of gas turbine plant? 4

   (b) Write the comparison between closed and open cycle gas turbine for the following criteria: type of working fluid, type of fuel, efficiency and size of plant. 4

   (c) The following reading were recorded during two hour trial on a boiler :

Feed water supplied	= 14000 kg
Boiler working pressure	= 10 bar
Dryness fraction of steam	= 0.96
Temperature of feed water entering	= 35 °C
Temperature of feed water leaving	= 90 °C
Coal burnt	= 1500 kg
Temp of steam leaving superheater	= 335 °C
C V of coal	= 25000 kJ/kg

   Find:

   i) Enthalpy received by feed water in economizer, boiler and super heater 6

   ii) percentage of heat supplied in boiler & superheater 4

   iii) Overall thermal efficiency of plant 2

Turn Over

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3. (a) Explain the construction and working of once through boiler with neat sketch. 8

(b) In an impulse turbine, steam issues from the nozzle with a velocity of 850 m/s. The nozzle angle is 20°. Mean blade velocity is 350 m/s and blades are equiangular. Mass flow rate of steam is 1000 kg/min. The friction factor is 0.8 determine: 12

i) Blades angles
ii) Power developed in kW
iii) Blade efficiency
iv) Stage efficiency if nozzle efficiency is 93%.

4. (a) What is the purpose of compounding of steam turbine? Explain pressure compounding method with neat sketch. 8

(b) In a gas turbine plant compressor takes in air at a temperature of 15°C and compresses it to four times the initial pressure with an isentropic efficiency of 85%. The air is then passed through a heat exchanger, heated by turbine exhaust before combustion chamber. Turbine inlet temperature is 600 °C and its efficiency is 80%. Neglecting all losses except mentioned and considering air as the working fluid calculate thermal efficiency and work ratio of the cycle if (i) heat exchanger is perfect (ii) effectiveness of heat exchanger = 0.85. 12

5. (a) Explain 'cavitation' in hydraulic turbines. What are its effects? How it can be reduced? 6

(b) Explain the difference between mountings and accessories 4

(c) A turbine is to operate under a head of 25 m at 200 rpm. If the discharge is 9 m^3/s and turbine efficiency is 90%, calculate power generated by turbine, specific speed of the turbine and performance of the turbine under a head of 20 m. 10

6. (a) A Pelton wheel has to be designed for the following data. Power developed = 6000 kW, net head available = 300 m, speed = 550 rpm, ratio of jet diameter to wheel diameter = 1/10 and overall efficiency = 85%. Find number of jets, diameter of jet, diameter of wheel and quantity of water required. Assume K_v = 0.98 and K_u = 0.46 10

(b) Explain construction and working of ramjet. Write its applications also. 6

(c) Write the working principle of rocket engine. 4

AUTO/ Sem VII / CBSGS/ OR / 08/06/17

T0526 / T0888 OPERATIONS RESEARCH

Q.P.Code: 018190

(3 Hours) [Total Marks: 80]

N.B. (1) Question number 1 is compulsory and answer any three from the remaining.

(2) Graph paper should be given on demand.

(3) Digits in the right indicates full marks.

Q.1. (a) Assign the four subjects to three faculty members. Students have to study One subject on their own. The matrix given below indicates the marks score and the objective is to score maximum marks. (5)

Faculty	Subjects			
	S1	S2	S3	S4
P1	60	40	70	50
P2	45	55	65	60
P3	30	35	55	50

(b) What is Monte Carlo simulation technique. How it will be applicable in solving Queuing problem. (5)

(c) Write Dual of the following LPP (5)

Maximize $Z = 3x + 5y + 4z$

Subject to

$3x + 2y + 2z \leq 12$

$2x + 2y + z \geq 8$

$x + 2y + 3z = 15$

$x, y \geq 0$

(d) Write short note on resource leveling. (5)

Q.2. (a) Explain the following terms with suitable examples – infeasible solution and unbounded solution in the context of Linear Programming Problem. (4)

(b) Solve the following game and find the value of game. (6)

	1	2	3	4	5
I	1	3	2	7	4
II	3	4	1	5	6
III	6	5	7	6	5
IV	2	0	6	3	1

TURN OVER

(c) Solve the following LPP (10)

Maximize,

$$Z = 16 X_1 + 17 X_2 + 10 X_3$$

Subject to,

$X_1 + X_2 + 4X_3 \leq 2000$; $2X_1 + X_2 + X_3 \leq 3600$;

$X_1 + 2 X_2 + 2 X_3 \leq 2400$; X_1, X_2 & $X_3 \geq 0$

Q.3 (a) Nagpur Orange Grower Association has three canning factories. Oranges are transported from three Orchards. Transportation costs per ton, capacities of Orchards and requirements of factories are given in the table. Determine the optimal transportation Mix. (10)

	Factories			Capacity
Orchards	**1**	**2**	**3**	**4**
A	3	7	8	30
B	1	4	8	30
C	5	2	5	40
D	10	3	2	50
Requirements	20	60	70	

(b) For a given network data, draw the network, determine the total float, independent and interfering floats and identify the critical path. (10)

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	2	8	10	6	3	3	7	5	2	8

Q.4. (a) At a booking window customers arrive at the rate of 10 per minute approximated to Poisson's distribution. If the service time is exponentially distributed with a mean of 15 per minute, determine (10)

a) Probability that booking clerk waits for the customer

b) Probability that there are at least 3 customers in the queue

c) Average number of customers in the system

d) Average time spent in the queue

e) Probability that the customers will be served within four minutes

(b) Solve the following game. Find the strategies and value of game. (10)

Player A	Player B			
	A	**B**	**C**	**D**
P	3	2	4	0
Q	3	4	2	4
R	4	2	4	0
S	0	4	0	8

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Q.5. (a) A company manufactures 30 units per day. Sale of these items depends upon demand which has the following distribution:

Sales (units)	27	28	29	30	31	32
Probability	0.10	0.15	0.20	0.35	0.15	0.05

Production cost and sales price of each unit are Rs.40 and Rs.50 respectively. Any unsold product is to be disposed off at a loss of Rs.15 per unit. There is penalty of Rs.5 per unit if the demand is not met. Using the following random numbers estimate the total profit / loss for the next ten days: 10, 99, 65, 99, 95, 01, 79, 11, 16, 20. **(10)**

(b) A Company has a demand of 12,000 units/year for an item and it can produce 2,000 such items per month. The cost of one set up is Rs. 400 and the holding cost/units/month is Rs. 0.15 Find the optimum Lot size and total cost per year, assuming the cost of one unit as Rs. 4. Also find the maximum inventory, manufacturing time and total time. **(10)**

Q.6. (a) Solve the following LPP by Graphical Method **(05)**

Maximize $Z = 8x + 16y$

Subject to

$x+y \leq 200$; $3x + 6y \leq 900$; $y \leq 125$;

$x, y \geq 0$,

(b) A newspaper boy has the following probabilities of selling a magazine: **(10)**

No. of copies sold	10	11	12	13	14
Probability	0.10	0.15	0.20	0.25	0.30

Cost of copy is 30 paise and sale price is 50 paise. He cannot return unsold copies. How many copies should he order?

(c) Explain different behavior of server and customers in the queue. **(05)**

AUTO / VI / C6565 / FEA / 14-6-17

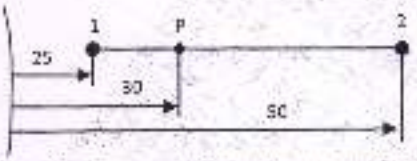
Q.P. Code:18542

(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

Question No.		Max. Marks
Q.1	Attempt any four:	20
	a) Explain the terms "Preprocessor", "Solver" and Postprocessor"	
	b) Explain the characteristics of shape function.	
	c) A 1D spar element having a linear shape function is as shown below. Find the natural co ordinate of point P. If the temperature at node 1 is 50°C and at node 2 is -20°C, find the temperature at point P.	



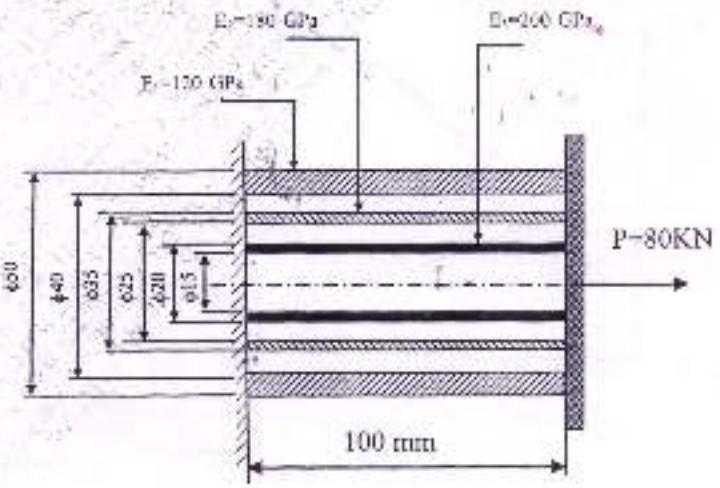
	d) Mention the displacement boundary conditions for different support condition – free, fixed, roller and pinned.	
	e) What do you mean by consistent and lumped mass matrices?	
Q.2	a) Solve the following differential Equation using Galerkin Method.	10

$$\frac{d^2u}{dx^2} + 5 = 0 \text{ for } 0 < x < 1$$

Boundary Conditions are: $u = 0$ at $x = 0$ and $\frac{du}{dx} + u = 0$ at $x = 1$.

Find u(0.2) and compare with exact solution.

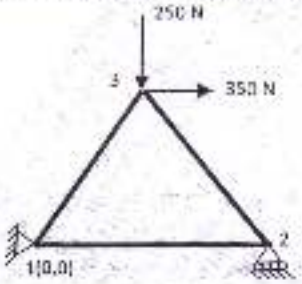
	b) Three concentric rings of different materials are joined together as shown in figure. Determine the displacement at the free end.	10



Q.3 a) Write a note on skyline and banded matrix of storing data. 6

b) A three bar equilateral triangular truss has the three members of length 1m each. The bottom support are 1 and 2, whereas the top joint is 3. Support at the end 1 is fixed, while end 2 has a roller support. It is subjected to load as shown. Assuming the modulus of elasticity of the material as 2×10^5 N/mm^2 and the cross sectional area as 600 mm^2, determine 14

1. Displacement at each node.
2. Stresses induced in each element.
3. Reaction at supports



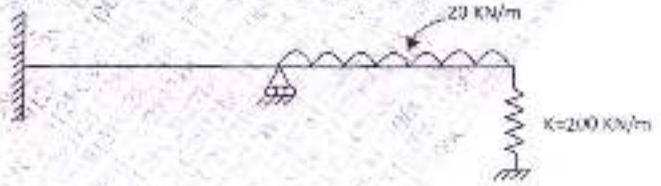
Q.4 a) Using R-R Method mapped over general element solve, 10

$$\frac{d}{dx}\left(a\frac{du}{dx}\right) + bu + c = 0;\ 0 \le x \le L$$

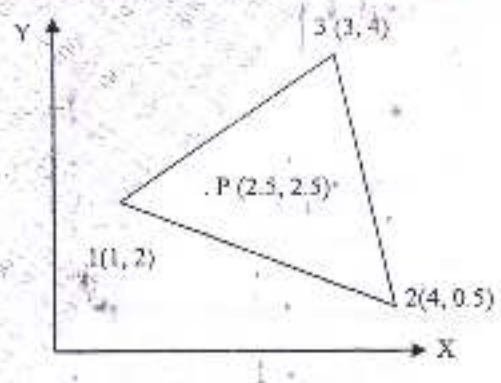
Global boundary conditions are, $u(0) = u_0$ and $a\left(\frac{du}{dx}\right)\Big|_{x=L} = 0$

Use Lagranges Linear shape functions.

b) Find the deflection and slopes at nodes and reactions at supports for the beam as shown in figure. The beam is fixed at node 1, has a roller support at node 2 and has an elastic spring support at node 3. Assume E = 210 GPa and I = 2×10^{-5} m^4 throughout the beam. 10



Q.5 a) The nodal coordinate of the triangular element for ground water simulation is as shown in figure. The nodal values of hydraulic heads (ϕ) at the nodes are (3.5, 2.2, 4.4) respectively. Find the value of the hydraulic head at pint P. 10



10

b) A constant strain triangle element has the nodal coordinates (1, 2), (4, 0.5) and (3, 4) 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:

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

Determine-

i) The Jacobian for (x,y)-(ξ,η) transformation
ii) The strain-displacement relation matrix
iii) The strains
iv) The element stresses.

Q.6 a) Derive the shape functions for a linear quadrilateral element and show it's variation over the element. 10

b) Find the natural frequency of axial vibrations of a bar of uniform cross section of $30mm^2$ and length 1m. Take $E = 2 \times 10^7$ N/mm^2 and $\rho = 8000$ kg/m^3, Take two linear elements. Compare the natural frequencies with exact frequencies. 10