CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, July/August 2021
Dynamics of Machines

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Discuss the static equilibrium of
   i) Two forces
   ii) Three forces
   iii) Member with two forces and a torque. **(06 Marks)**

b. A four bar mechanism under the action of two external forces is shown in Fig.Q.1(b). Find the required input torque on the link AB for static equilibrium. The dimensions of the links are AB = 50mm, BC = 66mm, CD = 55mm, CE = 25mm, CF = 30mm, angle BAD = 60° and AD = 100mm. **(14 Marks)**

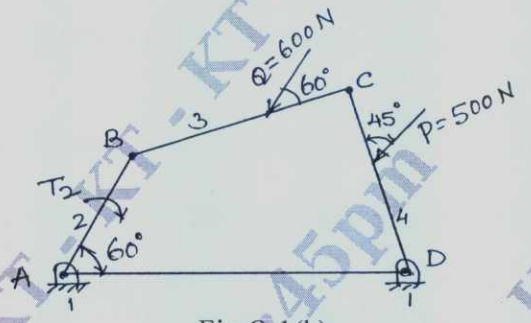

Fig.Q.1(b)

2 a. Explain in brief D'Alembert's principle and state why it is used. **(06 Marks)**

b. The piston diameter of an internal combustion engine is 125mm and the stroke is 220mm. The connecting rod is 4.5 times the crank length and has a mass of 50kg. The mass of the reciprocating parts is 30kg. The centre of mass of the connecting rod is 170mm from the crank pin centre and the radius of gyration about an axis through the centre of mass is 148mm. The engine runs at 320rpm. Find the magnitude and the direction of the inertia force and the corresponding torque on the crank shaft when the angle turned by the crank is 140° from the inner dead centre using Analytical method. **(14 Marks)**

3 a. Explain static balance and dynamic balance as applied to revolving masses in different planes. **(04 Marks)**

b. A shaft carries three masses in planes A, B and C. Planes B and C are 600mm and 1200mm from plane A. Masses in planes A, B and C are 50kg, 40kg and 60kg respectively at a radius of 25mm. The angular position of mass B and C with A are 90° and 210° respectively. Find the unbalanced force and couple if the shaft revolves at 300rpm. Also find the position and magnitude of balancing mass required at 100mm radius in planes "L" and "M" midway between A and B between B and C. **(16 Marks)**

4 a. Explain the terms primary balancing and secondary balancing as used for balancing of reciprocating masses. **(05 Marks)**

b. A four cylinder vertical engine has cranks 300mm long. The planes of rotation of first, third and fourth crank are 750mm, 1050mm and 1650mm respectively from that of the second crank and their reciprocating masses are 150kg, 400kg and 250kg respectively.

i) Find the mass of the reciprocating parts for the second cylinder and the relative angular positions of the cranks in order that the engine may be complete primary balance.

ii) If each connecting rod of all four cylinders to 1.35m long and the speed is 300rpm find maximum unbalanced secondary force and couple and crank positions at which maximum unbalanced secondary force and couple occur. **(15 Marks)**

5 a. Derive an expression for speed of a porter governor with usual notations taking friction in to account. **(10 Marks)**

b. In a Hartnell Governor the length of ball and sleeve arms are 12 and 10cm respectively. The distance of fulcrum of the bell crank lever from the governor axis is 140mm. Mass of each governor ball is 4kg. When the governor runs at the mean speed of 300rpm, the ball arm is vertical and sleeve arm is horizontal. For an increase of speed of 4% the sleeve moves 10mm upward. Neglecting friction, find:

i) Minimum equilibrium speed if total sleeve movement is 20mm.

ii) Spring stiffness

iii) Sensitiveness of Governor

iv) Spring stiffness if Governor is to be isochronous at 300rpm. **(10 Marks)**

6 a. Analyze the stability of a two wheel vehicle taking left turn. Derive the necessary equations. **(10 Marks)**

b. A ship is propelled by a turbine rotor which has a mass of 2500 kg and has a speed of 3200rpm clockwise direction when viewed from stern. The rotor has a radius of gyration of 0.4m. Determine the gyroscopic couple and its effect when.

i) The ship steers to the left in a curve of 80m radius at a speed of 15 knots (1 knot = 1860 m/h).

ii) The ship pitches 5 degrees above and 5 degrees below the normal position and the bow is descending with its maximum velocity. The motion due to pitching is simple harmonic motion and the periodic time of 40 seconds.

iii) The ship rolls and at the instant, its angular velocity is 0.04 rad/sec clockwise when viewed from stern.

iv) Also find the maximum angular acceleration during pitching. **(10 Marks)**

7 a. Briefly explain with neat sketches of Free, Forced, damped, undamped, longitudinal vibrations. Transverse and Torsional vibrations. **(10 Marks)**

b. Determine the equation of motion and the natural frequency of the system shown in Fig.Q.7(b), by using Newtons method and energy method. **(10 Marks)**

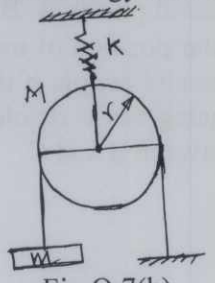

Fig.Q.7(b)

8 a. Define logarithmic decrement and derive the equation for same. **(10 Marks)**

b. A body of mass 7.5kg is suspended from a helical spring and makes damped oscillations. The time for 60 oscillation is 35sec and ratio of first to seventh displacement is found to be 2.5. Find: i) Stiffness of spring ii) Logarithmic decrement iii) Damping factor iv) Damping resistance and v) If the oscillations were critically damped, what is the damping resistance? **(10 Marks)**

9 a. Derive an expression for steady state amplitude of vibration of mass in a spring mass damper system, when the mass is subjected to harmonic excitation. **(10 Marks)**

b. A machine supported symmetrically on four springs has a mass of 80kg. The mass of the reciprocating parts is 2.2kg which more through a vertical stroke of 100mm with simple harmonic motion. Neglecting damping, determine the combined stiffness of the springs so that the force transmitted to the foundation is $\frac{1}{20}$th of the impressed force. The machine crank shaft rotates at 800rpm. If under actual working conditions, the damping reduces the amplitudes of successive vibrations by 30%, find the

i) Force transmitted to the foundation at 800rpm.
ii) Force transmitted to the foundation at resonance.
iii) Amplitude of the vibrations at resonance. **(10 Marks)**

10 a. Derive an expression for the natural frequency of free transverse vibrations for a simply supported beam or shaft carrying several loads by using

i) Dunkerley's method
ii) Energy method. **(10 Marks)**

b. The following data relate to a shaft held in long bearings:
Length of shaft = 1.2m
Diameter of shaft = 14mm
Mass of a rotor at mid point = 16kg
Eccentricity of centre of mass of rotor from centre of rotor = 0.4mm
Modulus of elasticity of shaft material = $200GN/m^2$
Permissible stress in shaft material = $70 \times 10^6 N/m^2$
Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft to be massless. **(10 Marks)**

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18ME54

Fifth Semester B.E. Degree Examination, July/August 2021
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions.***
2. ***Use of Steam table and Mollier chart are allowed.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. With a neat sketch, mention the parts of a Turbo machine. **(04 Marks)**

b. Differentiate Turbo machine with Positive displacement machine. **(06 Marks)**

c. A model of Kaplan turbine one tenth of the actual size is tested under a head of 5m when the actual head for the prototype is 8.5m. The power developed by the prototype turbine is 8000 kW when running at 120 rpm at an overall efficiency of 85%. Determine i) Speed ii) Discharge iii) Power developed iv) Specific speed of the model. **(10 Marks)**

2 a. With the help of h-s diagram, explain the efficiency of power generating type turbo machines. **(08 Marks)**

b. A 16 stage axial flow compressor is to have a pressure ratio of 6.3 and the stage efficiency of 89.5%. The intake conditions are 288K and 1 bar. Determine i) Overall efficiency ii) Polytropic efficiency iii) Preheat factor. **(12 Marks)**

3 a. Define the Degree of Reaction and Utilisation factor. Establish the relationship between them. **(08 Marks)**

b. The velocity of steam outflow from a nozzle in a impulse turbine is 1200 m/s. The nozzle angle being 22^0. If the rotor blades are equiangular and the diameter of runner is 3.5m and rotating with the speed of 2180 rpm. Determine i) Blade angles ii) Tangential force on the blade ring iii) Power output and iv) Utilization factor. Assume $Vr_1 = Vr_2$. **(12 Marks)**

4 a. Show that the degree of reaction for axial flow machine is given by

$$R = \frac{V_f[\tan\beta_1 + \tan\beta_2]}{2u[\tan\beta_1 \times \tan\beta_2]}$$

, where V_f = Velocity of flow. B_1 and β_2 are inlet and outlet blade angles. **(10 Marks)**

b. Show that the degree of reaction for Radial outward flow turbo machine is given by

$$R = \frac{2 + \cot\beta_2}{4}$$

, where β_2 = Blade angle at the exit. **(10 Marks)**

5 a. What do you mean by Compounding of Steam turbine? Explain two methods of Computing. **(08 Marks)**

b. Steam issuing from a nozzle to a De – Laval turbine with a velocity of 1000 m/s. The nozzle angle is 200, the mean blade speed is 400m/s. The blades are symmetrical. The mass flow rate is 1000 kg/hr, Friction factor is 0.8 , Nozzle efficiency = 0.95. Taking the scale of 1:100, find the following Graphically :
i) Blade angles ii) Axial thrust iii) Work done per kg of steam
iv) Power developed v) Blade efficiency vi) Stage efficiency. **(12 Marks)**

6 a. What is Reheating in Steam turbine? List the advantages and disadvantages of reheating. **(08 Marks)**

b. A 20 stage Parson's turbine receiver steam at 15 bar and 300^0C and the steam leaves the turbine at 0.1 bar. The turbine has a stage efficiency of 80% and the reheat factor is 1.06. The total power developed by the turbine is 10658 kW. Find the steam flow rate through the turbine. If the blade exit angle is 25^0, speed ratio is 0.75 and density of steam is 0.59 kg/m^3. Find the mean diameter of the stage and rotor speed. Assume the height of the blade is equal one twelveth of the mean diameter. **(12 Marks)**

7 a. Show that the maximum hydraulic efficiency for a Pelton turbine is given by $\eta_h = \frac{1+K\cos\beta}{2}$, where K = Bladevel coefficient , β = Nozzle angle. **(08 Marks)**

b. A double jet Pelton wheel is required to generate 7500 kW, when the available head at the base of the nozzle is 400m. The jet is deflected through 165^0 and the relative velocity of the jet is reduced by 15%in passing over the buckets. Determine
i) Diameter of jet ii) Total flow iii) Force exerted by the jet in the tangential direction **(12 Marks)**

8 a. Sketch and explain the construction and working of Francis turbine. **(06 Marks)**

b. What is Draft Tube? Explain the types and functions of the draft tubes. **(06 Marks)**

c. A Kaplan turbine working under a head of 15m develops 7350 kW. D_o = 4m , D_h = 2m. The guide blade angle is 30^0. The hydraulic efficiency and overall efficiency of the turbine are 90% and 85% respectively. If the velocity of the Whirl at outlet is zero, find i) Runner Vane angles ii) Speed of the turbine iii) Specific speed of the turbine. **(08 Marks)**

9 a. With reference to Centrifugal pump, define the following :
i) Static head ii) Delivery head iii) Manometric head
iv) Manometric efficiency v) Net Positive suction head. **(08 Marks)**

b. Derive the expression for minimum starting speed of a centrifugal pump. **(06 Marks)**

c. A centrifugal pump with impeller outside diameter of 200mm and rotates at 2900 rpm. The vanes are curved back at 25^0. The velocity of flow is constant at 3m/s. Assuming the hydraulic efficiency at 75% and determine the head generated. Also determine the power required to run the impeller if the breadth of the wheel at the outlet is 15mm. **(06 Marks)**

10 a. Define the Slip and Slip coefficient in Centrifugal Compressor. Also explain the effect of slip in the Centrifugal Compressor. **(06 Marks)**

b. Explain the Surging and Choking in Centrifugal Compressor. **(06 Marks)**

c. A Centrifugal Compressor has an inlet eye 15cm diameter. The impeller revolves at 20000 rpm and the inlet air has an axial velocity of 107 m/s, inlet stagnation temperature and pressure are 294 K and 1.03 bar respectively. Determine
i) Inlet Blade angle ii) Mach number. **(08 Marks)**

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18ME55

Fifth Semester B.E. Degree Examination, July/August 2021
Fluid Power Engineering

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Define fluid power technology. Mention the advantages and applications of fluid power system. **(06 Marks)**

b. What is Pascal's law? Explain the concept of force multiplication. **(06 Marks)**

c. Write notes on:
(i) Sealing materials
(ii) Pressure drop in hoses/pipes **(08 Marks)**

2 a. Explain the desirable properties of hydraulic fluids in industrial hydraulic systems. **(08 Marks)**

b. Explain the various filter locations used in filtering in hydraulic systems. **(06 Marks)**

c. Write a note on hoses and quick acting couplings. **(06 Marks)**

3 a. With a neat sketch, explain the construction and working of variable displacement vane pump. Also mention the difference between positive and non positive displacement pumps. **(10 Marks)**

b. Write a note on performance characteristics of gear pump. **(05 Marks)**

c. Explain briefly the gas loaded type of accumulator with a neat sketch. **(05 Marks)**

4 a. Explain the working of cushioning and telescopic cylinders with a neat sketch with suitable applications. **(10 Marks)**

b. A hydraulic motor has a volumetric displacement of 123×10^{-6} m^3. If it receives 0.0009 m^3/s of oil at 50 bars, find:
(i) Speed of the motor
(ii) Theoretical torque
(iii) Theoretical power of the motor **(06 Marks)**

c. Mention the difference between:
(i) Hydraulic pump and hydraulic motor
(ii) Linean Actuator and Rotary Actuator **(04 Marks)**

5 a. Give the classification of control valves. Also explain the different centre positions of 3 position 4 way direction control valves with symbolic representations. **(09 Marks)**

b. Discuss the working of pressure compensated flow control valve with a neat sketch. **(06 Marks)**

c. Give the symbolic representation of :
(i) Pressure relief valve
(ii) Pressure reducing valve **(05 Marks)**

6 a. Explain the following with a neat hydraulic circuits:
(i) Force Multiplication Circuit
(ii) Sequencing Circuit **(16 Marks)**

b. Explain the speed control of hydraulic cylinder involved with meter-in circuit. **(04 Marks)**

7 a. Discuss the structure of pneumatic control system with the aid of block diagram. Also mention the limitations of pneumatic system. **(08 Marks)**

b. List the characteristics of compressed air in pneumatic systems. **(06 Marks)**

c. Explain in brief FRL Unit with a neat diagram. **(06 Marks)**

8 a. Explain the working principles of the following pneumatic cylinders with neat sketches:
(i) Impact cylinder
(ii) Rodless cylinders **(08 Marks)**

b. Explain the following with neat sketches:
(i) Quick Exhaust Valve
(ii) Time Delay Valve
(iii) Shuttle valve **(12 Marks)**

9 a. Explain the direct and indirect actuation of cylinders in pneumatic systems with simple circuits. **(06 Marks)**

b. Explain the following pneumatic circuits:
(i) Supply Air Throttling
(ii) Exhaust Air Throttling **(06 Marks)**

c. Explain the OR Gate logic with truth table and symbol. **(08 Marks)**

10 a. Discuss the motion control diagram for a 2-cylinder circuit. **(12 Marks)**

b. Explain the use of relays in electro-pneumatic control. **(08 Marks)**

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18ME56

Fifth Semester B.E. Degree Examination, July/August 2021
Operations Management

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. What do you understand by the term Operations Management? Trace the historical events leading to study of operation management. **(07 Marks)**

b. Explain productivity. State the factors affecting productivity. **(05 Marks)**

c. A company has an order for a particular component is 100,000 units. There are two alternate methods to manufacture the product. The details of various costs are given below:

Investment details	A	B
(i) Investment on Machinery & Building	Rs.60,00,000	Rs.80,00,000
(ii) Other Fixed & production overheads	Rs.3,00,000	Rs.2,00,000
(iii) Variable production cost/unit	Rs.125	Rs.115
(iv) Variable selling expenses/unit	Rs.5	Rs.15
Selling price/unit	Rs.280	

(i) Which alternative is economical?

(ii) Estimate the loss of selecting wrong alternative. **(08 Marks)**

2 a. Explain the concept of production system with a schematic diagram. **(07 Marks)**

b. Sketch and explain the BEP analysis. Explain how it helps in decision analysis. **(05 Marks)**

c. A milk factory seeks advice concerning its business and production processes. The final report describes several steps to increase productivity. Accordingly following are the details:

	Existing system	Proposed system
Milk output/hour	1000 gallons	1400 gallons
Wage rate/hour	Rs.12	Rs.12
Filtration cost/hour	Rs.120	Rs.170
Workers	12	9

(i) Calculate labor productivity for both systems.

(ii) Find All Factor (AFP) for both systems. **(08 Marks)**

3 a. What Forecasting? Explain any two techniques. **(07 Marks)**

b. Explain any two Forecast Errors. **(05 Marks)**

c. The manager of a road transport company believes that the demand for tyres used on his trucks is closely related to the number of kilometers driven. Accordingly the following data covering past 7 months collected.

Duration	1	2	3	4	5	6	7
Kms driven in 1000	120	135	130	150	170	190	220
No. of tyres used	9.5	11.0	12.0	12.5	14.0	16.0	18.0

(i) Compute the coefficients a and b for the regression line.

(ii) Suppose the manager pans to drive 250000 kms, what is the expected number of tyres which will be used? **(08 Marks)**

4 a. What is coefficient of correlation? Explain tracking signal with a graph. **(06 Marks)**

b. What are the Time Series Components? Explain the processing steps in forecasting and limitations. **(06 Marks)**

c. Explain the difference between MA and EMA. Find the Weighted Moving Average of 3 and 5 months.

Months	Jan	Feb	Mar	Apr	May	Jun	Jul
Bottles	1325	1353	1305	1275	1210	1195	?

(08 Marks)

5 a. What are the various types of capacity? Explain the importance of capacity planning. **(06 Marks)**

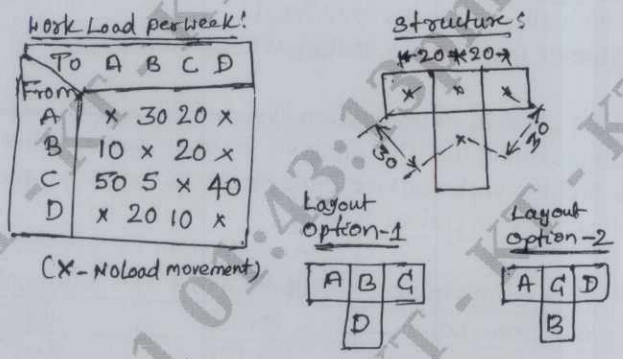
b. Explain any two types of layout. **(06 Marks)**

c. A metal processing firm wishes to install enough automobile molders to produce 250000 good castings per year. The molding operations takes 1.5 minutes per casting, but output is typically about 3% defective. How many molders will be required if each one is available for 2000 hours (of capacity) per year? **(08 Marks)**

6 a. List the various factors influencing plant location. Explain. **(06 Marks)**

b. Explain the various capacity measures. What are the capacity strategies? **(06 Marks)**

c. In a small factory two alternate layouts are to handle the following work load/week. Find the suitable option and optimum cost. **(08 Marks)**



7 a. What is Aggregate Planning? Explain its strategies. **(06 Marks)**

b. What are the Functions of Master Production Schedule? State the difference between AP and MPS. **(06 Marks)**

c. A manufacturing plant is in the process of updating its MPS for its products. The plant produces a product on a produce-to-stock basis. Table below shows the estimates of demand for the product for the next six weeks.

Types of Demand	Week					
	1	2	3	4	5	6
Customer forecast & orders	700	1200	700	500	400	1200
Warehouses	100	100	400	500	200	100
Market Research	-	50	-	-	10	-
Production Research	10	-	-	-	-	-

The plant starts with Beginning Inventory of 1500 units, the safety stock requirement of each week is 500 units and the minimum production. Lot size is 2000 units. Prepare a six week detailed master production schedule. Also Available-To-Promise for next 7th week. **(08 Marks)**

8 a. Explain the Master Production Schedule with a diagram. **(06 Marks)**

b. What are the objectives and strategies of MPS? **(06 Marks)**

c. Given the following information, set the aggregate planning problem as a transportation problem and find the solution using least cost method.

Forecast demand and production capacity:

Period	Available capacity units			Demand Forecast units
	RT	OT	SG	
1	500	50	120	520
2	500	50	120	720
3	500	50	100	750

Initial Inventory = 100 units, Final Inventory = 100 units, Inventory Carrying Cost = Rs.1/unit/period. Back ordering is not permitted. **(08 Marks)**

9 a. What are the objectives of MRP? Explain the input and outputs of MRP package. **(06 Marks)**

b. Explain the key features of MRP system. **(06 Marks)**

c. A company makes Q model from components R, S and T. Component R is made from 2 units of component X and 1 unit of component Y. Component T is made from 1 unit of component Y and 3 units of component Z.

(i) Draw the product structure tree for Q.

(ii) Actually company plans to build 100 units of Q, and having inventory of 150 units of T and 200 units of R. Find the gross and net requirements of T, R and S. **(08 Marks)**

10 a. Define supply chain. What are the key decisions in supply chain? **(06 Marks)**

b. Explain a typical supply chain system with a blank diagram. **(08 Marks)**

c. Explain Bullwhip effect. What are the root causes for bullwhip effect? **(06 Marks)**

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