Bharatiya Vidya Bhavan's

**Sardar Patel College of Engineering**

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

KT Exam

June 2018

Max. Marks: 100 Duration: 03 Hours

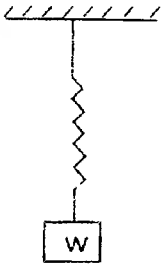
Class: T. Y. B. Tech Semester: V Program: Mechanical Engineering

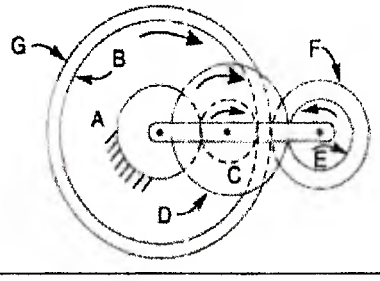
Name of the Course: Theory of Machines II Course Code : BTM402

**Instructions:**

1. Question No. 1 is compulsory; Attempt any four questions out of remaining six.
2. Attempt any five questions
3. Draw neat diagrams

| Question No | | Max Marks | Course outcome No | Module No. |
|---|---|---|---|---|
| Q1(a) | Explain design of block brake with short shoe | 04 | 1 | 1,2 |
| (b) | Explain<br>1. Reverted Gear Train<br>2. Gyroscopic effect on rolling of Ship | 04 | 1 | 5,6 |
| (c) | Describe with sketches one form of torsion dynamometer and explain with detail the calculations involved in finding the power transmitted. | 04 | 1 | 4 |
| (d) | Explain under damped, critically damped and over damped system with suitable example. | 04 | 1 | 1 |
| (e) | Describe the gyroscopic effect on sea going vessels. | 04 | 1 | 6 |
| Q2(a) | A lorry is moving on a level road at a speed of 36 km/h. Its centre of gravity lies at a distance of 0.6 m from the ground level. The wheel base is 2.4 metres and the distance of C.G. from the rear wheels is 0.9 m. Find the distance travelled by the car before coming to rest when brakes are applied, (a) to the rear wheels, (b) to the front wheels, and (c) to all the four wheels. The coefficient of friction between the tyres and the road surface is 0.45. | 10 | 1 | 1 |
| (b) | A centrifugal clutch is to transmit 15 kW at 900 r.p.m. The shoes are four in number. The speed at which the engagement begins is 3/4th of the running speed. The inside radius of the pulley rim is 150 mm and the centre of gravity of the shoe lies at 120 mm from the centre of the spider. The shoes are lined with Ferrodo for which the coefficient of friction may be taken as 0.25. Determine : 1. Mass of the shoes, and 2. Size of the shoes, if angle subtended by the shoes at the centre of the spider is 60° and the pressure exerted on the shoes is | 10 | 2 | 1 |

| | | | | |
|---|---|---|---|---|
| | 0.1 $N/mm^2$. | | | |
| Q3(a) | The helical spring as shown in figure has a mean coil diameter D=2.5 cm, a wire diameter d = 0.25 cm and contains n= 20 coils. The modulus of elasticity of the wire in shear is G = 8.4 X $10^5$ $Kg/cm^2$ and the suspended weight is W=15 Kg. Calculate the period of free vibrations.   | 15 | 2 | 5 |
| (b) | A weight if 1 Kg is attached to a spring having stiffness 4 Kg/cm. The weight slides on a horizontal surface, the coefficient of friction between the weight and surface being 0.1. Determine the frequency of vibration of the system and the amplitude after one cycle if the initial amplitude is 0.25 cm. Determine the final rest position. | 05 | 2 | 3 |
| Q4(a) | In a Porter Governor the links and arms are each 300 mm long. Each ball weights 2.5 kg and the central load is 250 N. For the highest and the lowest position of the sleeve , the arms are inclined at 40 degree and 30 degree respectively to the vertical. The friction at the governor and the mechanism connected to the valve is equivalent to a force of 25 N at the sleeve. Assuming that the links and arms intersect on the axis, find :<br>1. The travel of the sleeve<br>2. Minimum ascending speed<br>3. Maximum descending speed<br>4. Range of speed of the governor. | 15 | 2 | 4 |
| (b) | Derive an expression for natural frequency by using Rayleigh's method. | 05 | 1,3 | 4 |
| Q5 | The turbine rotor of a ship has a mass of 20 tonnes and a radius of gyration of 0.75 m. Its speed is 2000 r.p.m. The ship pitches 6° above and below the horizontal position. One complete oscillation takes 18 seconds and the motion is simple harmonic. Calculate :<br>1. The maximum couple tending to shear the holding down bolts of the turbine, 2. the maximum angular acceleration of the ship during pitching, and 3. the direction in which the bow will tend to turn<br>2. While rising, if the rotation of the rotor is clockwise when looking from rear. | 20 | 2,3 | 5 |

| | | | | |
|---|---|---|---|---|
| Q6(a) | Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600 mm. If one shafts runs at 120 rpm and the other at 360 rpm, find the number of teeth on each wheel if the module is 8 mm. Also determine the exact distance apart of shafts. | 08 | 3 | 6 |
| (b) | Fig. shows an epicyclic gear train with the following details :<br>A has 40 teeth external (fixed gear) ; B has 80 teeth internal ; C - D is a compound wheel having 20 and 50 teeth (external) respectively, E-F is a compound wheel having 20 and 40 teeth (external) respectively, and G has 90 teeth (external). The arm runs at 100 r.p.m. in clockwise direction. Determine the speeds for gears C, E, and B.<br>  | 12 | 3 | 6 |
| Q7(a) | Four masses A, B, C and D revolve at equal radii and are equally spaced along a shaft. The mass B is 7 kg and the radii of C and D make angles of 90° and 240° respectively with the radius of B. Find the magnitude of the masses A, C and D and the angular position of A so that the system may be completely balanced. | 15 | 3 | 7 |
| (b) | Explain Balancing of<br>1. In Line Engine<br>2. V Engine | 05 | 3 | 7 |

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Munshi Nagar, Andheri (West), Mumbai – 400058.

RE EXAMINATION ( June 2018)

**Q. P. Code:**

**Max. Marks: 100** **Duration: 3 Hour**

**Class: T.Y(Mechanical) Semester: V** **Program: B.Tech**

**Name of the Course: Mechatronics** **Course Code : BTM503**

**Instructions:**

**1. Answer any five questions including Q.No.1 which is compulsory.**

**2. Assume suitable additional data if necessary and state the same.**

| Q. No | | Max. Marks | CO No. | Module No |
|---|---|---|---|---|
| Q1 | Answer any four :- | 20 | | |
| | a) Frequency response analysis. | (5each) | 3 | 4 |
| | b) Classical solution of system equations to find response of a system. | | 2 | 4 |
| | c) Use of Sequence valve in hydraulic circuits | | 2 | 3 |
| | d) Comparison of Open and close loop control systems. | | 1 | 4 |
| | e)Advantages and applications of Micro-electromechanical systems(MEMS) | | 4 | 7 |
| | f) Counter relay function in electro pneumatic control. | | 1 | 2 |
| Q2 | A)For a unity feedback system, $G(s) = \frac{K}{S(S+2)(S+4)}$ Sketch the root locus showing all details on it. Comment on the stability of the system. | 12 | 3 | 6 |
| | B)A system has the transfer function $\theta_0 / \theta_i = 3 / [1+2D]$ Use the classical method to obtain and plot the response of the system $\theta_0$ (t), to a ramp input disturbance, $\theta_i$ =0.25t. | 08 | 3 | 4 |
| Q3 | A) Construct the Bode plot for a unity feedback control system having $G(S) = 100 / \{S(S+0.5)(S+10)\}$ Draw Bode plot. Determine G.M, P.M, $\omega_{gc}$ and $\omega_{pc}$. Give comments on stability. | 12 | 1 | 6 |
| | B) A system has $G(S)H(S) = K / \{S(1+2S)(1+0.1S)\}$ Find the value of K which makes the system just unstable. Use polar plot. | 08 | 3 | 6 |
| Q4 | A) Draw the block diagram of a microprocessor and explain the three segments (ALU, Register and Control unit) of a micro | 10 | 1 | 3 |

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| | processor.<br>State the characteristics, important features and functions of micro-processor.<br><br>B) Obtain the transfer function for the given system by using Block Diagram reduction technique (Fig 1) | 10 | 2 | 5 |
| Q5 | A) Devise a system , using a PLC, which can be used to control the movement of a piston in a hydraulic cylinder so that when a switch is momentarily pressed, the piston moves in one direction and when a second switch is momentarily pressed, the piston moves in the other direction. Consider a 5/2 double solenoid valve.<br><br>B)Examine the stability of the system by Routh's criterion:<br>a) $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$<br>b) $S^3 + 6S^2 + 11S + 6 = 0$<br>c) $S^3 + 3KS^2 + (K + 2)S + 4 = 0$( find the range of K for stablity) | 8<br><br>12 | 1<br><br>4 | 3<br><br>7 |
| Q6 | A)Two double acting pneumatic cylinders A & B are used in a mechanical system and the sequence of motion for the two pneumatic cylinders are:-<br>(AB) + / (A B)- /delay B+ / B-<br>Auxiliary condition is single or continuous cycle.<br>Use CASCADE METHOD to draw the pneumatic circuit.<br>Prepare the parts list.<br><br>B) With own circuit show the application of relay with delay in energizing in electro-pneumatic control. | 14<br><br>06 | 2<br><br>2 | 3<br><br>4 |
| Q7 | A) An electro-hydraulic system is selected for a sequential hydraulic cylinders actuation in an automation cycle.<br>The sequence of movements for the three cylinders is:<br>A + B + C+ / delay (ABC) -.<br>All the three cylinders are having single solenoid valves as final control valves.<br>The auxiliary condition is single cycle or continuous cycle.<br>When an Emergency switch is actuated all the three cylinders are to retract to the home position and the cycle can commence only when the emergency switch is disabled.<br>Draw the electro hydraulic circuit and prepare the parts list.<br><br>B) Draw the symbol of double acting intensifier used in hydraulic circuit and briefly explain the working of the intensifier with simple hydraulic circuit. | 14<br><br>06 | 2<br><br>4 | 3<br><br>3 |

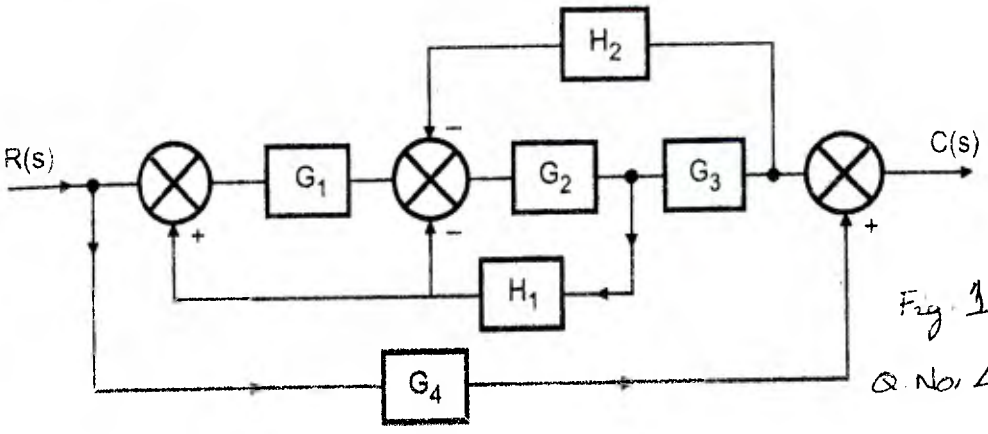


Fig 1

Q No. 4(B)

Bharatiya Vidya Bhavan's

# Sardar Patel College of Engineering

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Munshi Nagar, Andheri (West), Mumbai – 400058

**Re Exam**

**June 2018**

**Course code: BTM504**
**Program: T. Y. B. Tech**
**Semester: V**

**Duration: 3 Hours**
**Maximum Marks: 100**

**Name of the Course: Thermal Systems**

**Instructions:** 1. Question number ONE is compulsory and solve any FOUR questions out of remaining SIX.
2. Steam table and Mollier diagram is allowed to use.
3. Assume suitable assumptions and justify the same.

| Question No. | | Maximum Marks | Course Outcome Number | Module No. |
|---|---|---|---|---|
| **Q1** | | | | |
| **a)** | Explain multistaging of reciprocating air compressor. | **05** | CO1 | 2 |
| **b)** | Describe all the elements of condensing plant with its use. | **05** | CO1 | 5 |
| **c)** | Differentiate between high and low pressure boiler. | **05** | CO4 | 4 |
| **d)** | Write about various applications of gas turbine. | **05** | CO1 | 7 |
| **Q2** | | | | |
| **a)** | Consider a steam power plant operating on the simple ideal Rankine cycle. Steam enters the turbine at 3 MP and 350°C and is condensed in the condenser at a pressure of 75 kPa. Determine the thermal efficiency of this cycle. | **08** | CO3 | 1 |
| **b)** | A two stage double acting air compressor operating at 250 rpm takes air in at 1.013 bar and $27^0$ C. The diameter and stroke of L.P cylinder are 37 cm and 40 cm respectively. The stroke of H.P cylinder is same as L.P. cylinder and clearance of both the cylinder is 5% of the stroke. The L.P. cylinder discharges air at a pressure of 4.052 bar. The air passes through the intercooler so that it enters the H.P. cylinder at $27^0$ C and 3.85 bar. Finally, the air is discharged from the compressor at 15.4 bar. The compression and re-expansion in both the cylinder follows the same law $pv^{1.3}$ =Constant. Determine<br>(i) Brake power required to run the compressor if mechanical efficiency is 85 %<br>(ii) The diameter of H.P. cylinder<br>(iii) Heat rejected in intercooler.<br>Take $C_p$ = 1 kJ/kg-K and R = 287 J/kg-K for air. | **12** | CO3 | 2 |
| **Q3** | | | | |
| **a)** | Derive equation for critical pressure ratio of a nozzle and prove that for maximum discharge pressure ratio is given by:<br>$\frac{P_2}{P_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ | **10** | CO1 | 6 |

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|---|---|---|---|---|
| b) | Steam at a pressure of 20 bar with 50°C of superheat is allowed to expand through a convergent-divergent nozzle. The exit pressure is 1 bar. If the nozzle is required to supply 2 kg/sec of steam to the turbine, then calculate (i) velocities at throat and exit (ii) areas at throat and exit. | **10** | CO3 | 6 |
| **Q4** | | | | |
| a) | Explain with neat sketch working of root blower and vane-type blower. | **08** | CO2 | 3 |
| b) | A steam turbine develops 160 kW with a consumption of 19.4 kg/kWh. The pressure and temperature of the steam entering the nozzle are 12 bar and 220°C. The steam leaves the nozzles at 1.2 bar. If the diameter of the nozzle at throat is 7 mm, find the number of nozzles required. If 8 % of the total enthalpy drop is used up in frictional reheating in the diverging part of the nozzle, determine the diameter at the exit of nozzle and quality of steam leaving the nozzle. | **12** | CO3 | 6 |
| **Q5** | | | | |
| a) | Explain the working of Cochran boiler with neat sketch. | **10** | CO4 | 4 |
| b) | Draw neat sketch of surface condenser and explain its working. | **10** | CO4 | 5 |
| **Q6** | | | | |
| a) | Differentiate between axial and centrifugal compressors. | **08** | CO2 | 3 |
| b) | In a gas turbine installation, air is taken in L.P. compressor at 288K and 1.1 bar and after compression, it is passed through intercooler where its temperature is reduced to 295K. The cooled air is further compressed in H.P compressor and then passed in the combustion chamber where its temperature is increased to 950°C by burning the fuel. The combustion products expand in H.P. turbine which runs the compressor and further expansion is continued in L.P. turbine which runs the alternator. The gases coming out from L.P. turbine are used for heating the incoming air from H.P. compressor and then exhausted to atmosphere. Taking the following data determine the power output, specific fuel consumption and thermal efficiency. Pressure ratio in each compressor = 2, Isentropic efficiency of each compressor stage = 85%, Isentropic efficiency of each turbine stage = 85 %, Effectiveness of heat exchanger = 0.75, Air flow = 15 Kg/Sec, C.V. of fuel = 45000 kJ/Kg. $C_p$ (for air) = 1 kJ/kg-K, $C_p$ (for gas) = 1.15 kJ/kg-K, $\gamma$ = 1.4 (for air) and $\gamma$ = 1.33 (for gas). Neglect the mechanical, pressure and heat losses of the system and fuel mass also. | **12** | CO3 | 7 |
| **Q7** | | | | |
| a) | Derive equation for maximum efficiency of Parsons's steam turbine. | **10** | CO4 | 6 |
| b) | Why boiler mountings and accessories are used in the boiler? Explain with neat sketch Feed check valve and blow off cock used in boiler. | **10** | CO2 | 4 |

# BHARATIYA VIDYA BHAVAN'S
# SARDAR PATEL COLLEGE OF ENGINEERING
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Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination; May 2018

**Maximum Marks: 100** **Duration: 3 Hrs**

Class: **T.Y. B. Tech. (Mechanical Engg.)** Semester: **V**

Program: **B. Tech. (Mechanical Engineering)**

Name of the Course: **Hydraulic Machinery** Course Code: **BTME505**

**Instructions:**

1. **Question number 1 is compulsory.**
2. **Solve any 5 questions from remaining questions**
2. **Draw neat diagrams wherever necessary.**
3. **Assume suitable data if necessary.**

| Q. No. | | Max. Points | CO No. | BL |
|---|---|---|---|---|
| 1 | With neat labeled sketches explain working and utility of following hydraulic machineries (i) Pelton turbine (ii) Kaplan turbine (iii) Centrifugal Pump (iv) Reciprocating Pump | 20 | 1, 4 | 2, 3, 6 |
| 2 (a) | The three jet Pelton turbine is required to generate 10000 KW under a net head of 400 m. The blade angle at outlet is $15^0$ and the reduction in the relative velocity while passing over the blade is 5%. If the overall efficiency of the wheel is 80%, Cv=0.98 and speed ratio=0.46, then find: (i) the diameter of the jet (ii) total flow in $m^3/s$ and (iii) the force exerted by a jet on the buckets. If the jet ratio is not to be less than 10, find the speed of the wheel for a frequency of 50 Hz and the corresponding wheel diameter. | 10 | 3 | 3 |
| 2(b) | Write short notes on (i) Draft tube in reaction turbines (draw neat sketch) (ii) Selection of turbines | 10 | 4 | 4 |
| 3 (a) | Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000 KW under an effective head of 5 m. Overall efficiency of the turbine is 90%. The diameter of the boss is 0.4 times the external diameter of the runner. The turbine speed ratio is 2 and flow ratio is 0.6. What is the specific speed of the turbine? | 10 | 3 | 3 |
| (b) | Manometric head discharge characteristics of a centrifugal pump is given by the equation: $Hm=20+15Q-600Q^2$<br>Where Hm is in m and Q is in $m^3/s$. System curve for a typical installation is estimated as $10+900Q^2$ (Q is in $m^3/s$), where 10 is static head in m. If the NPSHR characteristics of the pump is given by equation: $NPSHR=20Q+60Q^2$<br>where Q is in $m^3/s$, evaluate how high the pump can be safely installed above the sump if suction pipe diameter is 15 cm, pipe length on suction side is 1.5 times static suction lift and 'f' for the pipe is 0.016. Evaluate the cavitation parameter 'σ' if pump runs at 1440 rpm and operates at duty point. Calculate the specific speed and suction specific speed. Take atmospheric and vapour pressure being 10.3 and 2.5 mWc respectively. | 10 | 3 | 7 |
| 4 (a) | Write short note on (i) Cavitation in turbine (ii) Significance of similarity laws in hydraulic machineries | 10 | 4 | 4 |

| | | | | |
|---|---|---|---|---|
| (b) | Find the height from the water surface at which a centrifugal pump may be installed in the following case to avoid cavitation:<br>Atmosphere pressure =1.01 bar (abs); vapour pressure =0.022 bar (abs); inlet and other losses in suction pipe 1.42 m, effective head of pump=49 m; and cavitation parameter=0.115. | 5 | 3 | 7 |
| (c) | Write short note on working and significance of air vessel in reciprocating | 05 | 1 | 5 |
| 5 (a) | The impeller of a centrifugal pump has an outer diameter of 250 mm and an effective area of 0.017 $m^2$. The blades are bent backwards so that the direction of outlet relative velocity makes an angle of $148^0$ with the tangent drawn in the direction of impeller rotation, the diameters of suction and delivery pipes are 150 mm and 100 mm respectively. The pump delivers 0.031 $m^3/s$ at 1450 rpm when the gauge points on the suction and delivery pipes close to the pumps shows heads of 4.6 m below and 18 m above atmosphere respectively. The head losses in the suction and delivery pipes are 2 m and 2.9 m respectively. The motor driving the pump delivers 8.67 KW. Assuming that water enters the pump without shock and whirl, determine:<br>(i) The manometric efficiency, and<br>(ii) The overall efficiency of the pump. | 10 | 2 | 6 |
| (b) | What is negative slip in reciprocating pump? Explain the same with the help of indicator diagram. | 05 | 2 | 6 |
| (c) | Draw rough nature of Head-Discharge (Hm Vs Q) characteristics of forward faced, radial, and backward faced impeller outlet vane angle of centrifugal pump. Explain why generally centrifugal pump impeller with backward faced outlet vane angle is preferred in design? | 05 | 3 | 6 |
| 6 (a) | An inward flow reaction turbine has external and internal diameters as 1.08 m and 0.54 m. The turbine is running at 200 rpm. The width of the turbine at inlet is 240 mm and velocity of flow through the runner is constant and is equal to 2.16 m/s. The guide blades makes an angle of $10^0$ to the tangent of the wheel at inlet and discharge at the outlet of the turbine is radial. Draw rough nature of inlet and outlet velocity triangles and determine (i) The absolute velocity of water at inlet (ii) The velocity of whirl at inlet (iii) The relative velocity at inlet (iv) The runner blade angles (v) width of runner at outlet (vi) weight of water flowing through the runner per second (vii) Head at inlet of the turbine (viii) Runner power (ix) Hydraulic efficiency of the turbine. | 10 | 3 | 3 |
| (b) | Write short notes draw neat sketches) on (i) Screw pump (ii) Gear pump<br>(support notes with neat sketches) | 10 | 1 | 6 |
| 7 (a) | A hydraulic turbine is to develop 1015 KW when running at 120 rpm under a net head of 12 m. Work out the maximum flow rate and specific speed for the turbine if the overall efficiency at the best operating point is 92%. In order to predict its performance, a 1:10 scale model is tested under a head of 7.2 m. What would be the speed, power output and water consumption of the model if it runs under the conditions similar to the prototype? | 10 | 3 | 4 |
| (b) | Two inward flow reaction turbines have the same diameter of 0.70 m and the same hydraulic efficiency. Both the runners work under the same head and they have same inlet velocity of flow of 5.8 m/s. One of the runners (A) revolves at a speed of 500 rpm and the inlet blade angle is $65^0$. If the other runner (B) has an inlet blade angle of $115^0$, what is its speed? (Assume outlet discharge to be radial in both the turbines) | 10 | 3 | 3 |