Seat No.

T.E. (Mechanical) (Part-III) (Semester - VI) (Revised) Examination, November - 2017
METROLOGY AND QUALITY CONTROL
Sub. Code :66839

Day and Date : Friday , 03 - 11 - 2017   **Total Marks : 100**

Time : 2.30 p.m. to 5.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to right indicate full marks.
3) Draw neat labeled sketch wherever necessary.
4) Assume any data if necessary and state it clearly

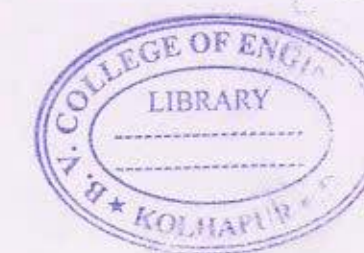**Q1)** Solve any two of the following   **[18]**

a) What is the limit gauges. Explain the 'Taylor's principle for design of 'limit gauges'

b) Explain the following terms with neat sketch.

    i) Unilateral tolerance

    ii) Bilateral tolerance

    iii) Upper deviation

    iv) Lower deviation

c) Calculate the limits of the following 25 H7 d8 designated fit, identify it and draw it graphically, the standard tolerance is given by

$$i = 0.45D^{\frac{1}{3}} + 0.001D$$

    i) 25 lies between steps of 18-30mm

    ii) Fundamental deviation of d shaft$=-16D^{0.44}$

    iii) for grade IT7 tolerance = 16i and for IT8 tolerance=25i

    iv) Fundamental deviation of H-hole=0

P.T.O.

22 Solve any two of the following   [16]

    a)   Compare mechanical comparator with optical comparator with the help of neat sketches.

    b)   Explain the use of sine bar for measuring an angle with the help of neat sketch and state its limitations.

    c)   Explain construction, working and limitations of sigma comparator.

23) Solve any two of the following   [16]

    a)   Define straightness and flatness. Briefly explain how straightness and flatness is measured and specified.

    b)   Explain principle and working of Tomlinson's surface meter with neat sketch.

    c)   Define surface texture, Lay and explain ten point average method for surface finish measurement.

24) Solve any two of the following   [16]

    a)   Define major diameter, effective diameter and enumerate various errors in screw thread.

    b)   Derive an expression for effective diameter measurement by 2-Wire method for external threads.

    c)   Describe the gear tooth vernier caliper and explain its use for checking tooth thickness.

25) Solve any two of the following   [16]

    a)   Differentiate between quality control and quality assurance.

    b)   What is cost of quality? Explain cost of failure, cost of appraisal and cost of prevention.

    c)   Discuss the factors that control, quality of design and quality of conformance.

26) Solve any two of the following   [18]

    a)   State the advantages, applications of control charts and sketch different patterns of control charts

    b)   Discuss following acceptance sampling terms

       i)   Average out going quality

      ii)   Average out going quality level

     iii)   Accepted quality level

    c)   A machine is working to a specification 80.75 ± 0.1mm a study of 32 consecutive pieces shows the following measurements. Construct the $\overline{X}$ and R chart and calculate process capability (For sample size of 8 take $A_2 = 0.37$, $D_4 = 1.86$, $D_3 = 0.14$, $d_2 = 2.847$)

1st day	2nd day	3rd day	4th day
80.74	80.76	80.77	80.73
80.73	80.76	80.72	80.75
80.72	80.75	80.77	80.81
80.74	80.73	80.71	80.77
80.74	80.75	80.73	80.74
80.76	80.75	80.74	80.74
80.78	80.77	80.76	80.80
80.78	80.77	80.80	80.81

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Seat
No.

T.E. (Mechanical) (Semester - VI) (Revised)
Examination, November - 2017
INDUSTRIAL FLUID POWER
Sub. Code: 66838

Day and Date : Thursday, 02 - 11 - 2017   **Total Marks : 100**
Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) All questions are compulsory.
               2) Draw neat diagrams/sketches wherever necessary.
               3) Figures to right indicates full marks.

Q1) Solve any two:

a) Explain in brief the basic requirements of a Pneumatic system.   **[7]**

b) Explain the important properties of hydraulic fluids.   **[7]**

c) Draw the symbols and explain the function of the following elements:**[7]**

   i) F.R.L unit

   ii) Four way, three position-open center solenoid operated D.C valve.

   iii) Weight loaded Accumulator.

   iv) time delay valve.

Q2) Solve any three:

a) Explain the working of swash plate type axial piston pump with neat
   sketch.   **[6]**

P.T.O.

b) Explain the function of cushioning in cylinders with neat sketch. [6]

c) Explain fluid conditioning and also explain with neat symbols types of reservoirs. [6]

d) Classify intensifiers and explain any one of them. [6]

Q3) Solve any three:

a) Draw a schematic of 4/2 pilot operated DCV and briefly explain its function. [6]

b) Draw schematically a sequence valve and explain its function. [6]

c) Explain the working of pressure compensated flow control valve with neat sketch. [6]

d) Explain use of any two center positions of D.C valves in hydraulic circuits. [6]
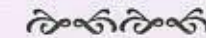
Q4) Solve any three:

a) Explain with neat sketch working of screw compressor used in pneumatic systems. [6]

b) Explain schematically different piping layouts in Pneumatic systems. [6]

c) Explain with the help of neat sketch the construction and working of air motor. [6]

d) Explain the working of 5/2 Direction control valve with a neat sketch. [6]

Q5) Solve any Three.

a) A vehicle is raised and held for about five hours and is to be descended slowly without any jerks, suggest and draw a suitable hydraulic circuit for the same. [6]

b) Explain the speed control circuit for an air motor. [6]

c) With the aid of circuit diagram explain the use of shuttle valve in pneumatic circuit. [6]

d) Explain with circuit diagram travel dependent sequencing mechanism in hydraulic system. [6]

Q6) Write short notes on: (Solve any two)

a) Pneumatic servo system. [7]

b) Safety precautions in handling hydraulic systems. [7]

c) Fluidics. [7]

What will be your decision under the following approaches

i) Optimistic Criterion

ii) Pessimistic Criterion

iii) Leplace Criterion

iv) Hurwicz Criterion ($\alpha = 0.7$)

c) Draw the project network for the following activities and determine critical path and project duration.

Activity	Preceding activity	Duration (days)
A	-	8
B	A	12
C	A	8
D	B,C	7
E	A	8
F	D,E	17
G	C	21
H	F,G	9
I	H	11

d) Determine optimal sequence, elapsed time and idle time of the following six jobs on the machine M1,M2 and M3 used in the same sequence to process these jobs.

Machines	Jobs					
	J1	J2	J3	J4	J5	J6
M1	15	14	16	13	10	8
M2	8	10	7	15	11	9
M2	8	10	7	15	11	9

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Seat No.

T.E. (Mechanical) (Part - II) (Semester - VI) (Revised) Examination, November - 2017
INDUSTRIAL MANAGEMENT & OPERATIONS RESEARCH
Sub. Code: 66837

Day and Date : Wednesday, 01 - 11 - 2017   Total Marks : 100
Time : 2.30 p.m. to 5.30 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable data, if necessary.
4) All questions are to be solved on one answer book only.

Q1) Attempt any four (5 Marks Each)   **[20]**
a) State the need of planning in manufacturing a component from vendors.
b) Explain in brief Process of Organizing.
c) Is there any difference between Authority & Responsibility. Justify your answer with suitable example.
d) Discuss the implications of the Herzberg's theory as a strategy for motivating employees.
e) Whether controlling is an essential function of management? If yes then explain the steps involved in controlling process?

Q2) Attempt any two (6 Marks Each)   **[12]**
a) Which factors related to environmental influence sugar manufacturing industry?
b) What are the problems of SSI involved in manufacturing components of automobile sector?
c) How to prevent an accident in a gas welding section of fabrication unit? Does the purchasing of safety equipments increases cost of operation?

Q3) Write short notes on any three (6 Marks Each)   **[18]**
a) Types of markets
b) 4 P's of market
c) Functions of Purchase department
d) Purchase policy and procedure
e) Cost estimation

Q4) Attempt any three (6 Marks Each) [18]

a) Define Operations Research. Briefly explain the characteristics of Operations Research.

b) Use graphical method to solve the following,

Maximize $Z = 5X_1 + 4X_2$

Subjected to constraints,

$5X_1 + 2X_2 \leq 40$,

$3X_1 + 3X_2 \leq 30$

$3X_1 + 5X_2 \leq 45$

$X_1, X_2 \geq 0$.

c) A company manufactures three jobs namely X, Y and Z. Each of the product require processing on three machines, Turning, Milling and Drilling. Product X requires 5 hours of turning, 2 hours of milling and 20 minutes of drilling. Product Y requires 3 hours of turning, 5 hours of milling and 30 minutes of drilling, and Product Z requires 1 hour of turning, 2 hours of milling and 30 minutes of drilling. In the coming planning period, 270 hours of turning, 220 hours of milling and 50 hours of drilling are available. The profit contribution of X,Y and Z are Rs. 500, Rs.750 and Rs. 1000 per unit respectively. Formulate LPP to maximize the profit. Suggest suitable method for solution of LPP.

d) Use simplex to solve the following problem and obtain initial and second feasible solution (two simplex tables only)

Minimise $Z = 5X_1 + 3X_2 + 2X_3$

subjected to constraints,

$3X_1 + 2X_2 + 2X_3 \leq 120$,

$2X_1 + 3X_2 + 3X_3 \leq 240$

$X_1, X_2, X_3 \geq 0$.

Q5) Attempt any two (7 Marks Each) [14]

a) How does the problem of degeneracy arise in a transportation problem? Explain how one can overcome it?

b) The unit transportation cost along with capacity and requirements from a supplier to a restaurant is as given below

Supplier	Restaurant				Capacity
	1	2	3	4	
A	25	40	75	20	4000
B	50	40	65	25	3000
C	25	50	70	40	3000
Requirements	1600	2400	3000	2000	

Obtain initial basic feasible solution by least cost method & VAM

c) A company has four workers and five jobs. Expected profit in Rs. for each job when assigned to different workers is given in the matrix below. Solve the assignment problem & estimate the total profit

Worker	Jobs				
	A	B	C	D	E
1	60	76	48	99	80
2	69	82	59	71	57
3	85	90	109	69	79
4	46	62	85	75	78

Q6) Write short notes on any three (6 Marks Each) [18]

a) Explain the various quantitative methods that are useful for decision making under risk.

b) The following matrix gives the payoff (in Rs.) of different strategies against events.

Strategies	Events			
	E_1	E_2	E_3	E_4
S_1	4,000	100	6,000	18,000
S_2	20,000	5,000	400	0
S_3	20,000	15,000	2,000	1,000

**T.E. (Mechanical) (Part - III) (Semester - V) (Revised)
Examination, November - 2017**
MANUFACTURING ENGINEERING
Sub. Code : 66245

Day and Date : Wednesday, 22 - 11 - 2017   **Total Marks : 100**
Time : 9.30 a.m. to 1.30 p.m.

Instructions :   1)   All questions are compulsory.
                  2)   Figures to the right indicate full marks.
                  3)   Assume if necessary suitable data and state them clearly.
                  4)   Use of non-programmable calculators is permissible.

SECTION - I

Q1) Solve any two:

   a)   Explain with neat sketch the types of milling cutters.   **[8]**

   b)   Derive an expression for Shear strain.   **[8]**

   c)   In an Orthogonal cutting of the material, Cutting force (F_H) =138Kg,
        Feed force (F_v) = 68Kg, Rake angle (α) =7°, Chip thickness ratio
        (r) = 0.4. Determine

        i)   Coefficient of friction of chip

        ii)   Shear force (Fs) and normal to shear force (Fn).   **[8]**

Q2) Solve the following questions.

   a)   Define machinability. Explain the factors affecting machinability. How
        the machinability index is defined?   **[8]**

                              OR

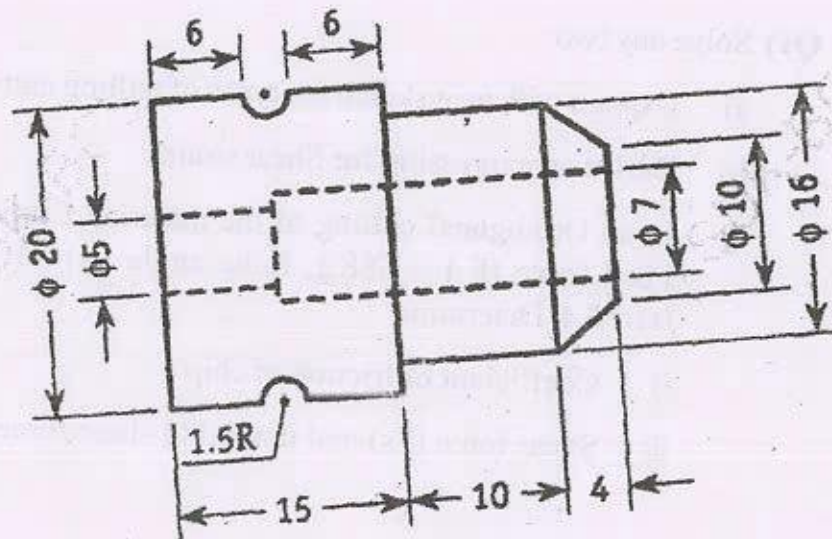   a)   Explin concept of wear & types of wear with sketch.   **[8]**

   b)   Determine   **[8]**

P.T.O.

i) Taylor's Tool life equation

ii) Cutting speed for 6 minutes of tool life when tool life of 70 minutes is obtained at a speed of 25m/min and 15 minutes at 40m/min.

The component shown in fig. is to be processed on a single spindle automat. **[18]** Study the component and prepare:

a) Detailed process sheet

b) Tool Layout

c) Cam profile for drilling operation-of ϕ5 mm hole through

d) Calculate Production rate per hour
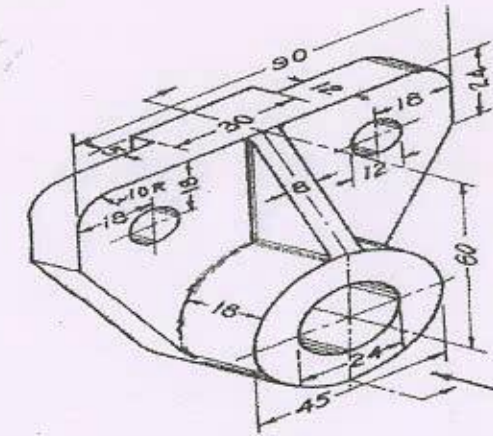
Material –ϕ 20 Bronze bar   All dimensions are in mm.

SECTION - II

Q4) Design & draw neat dimensional drawing in three views with one sectional view of jig for drilling two holes ϕ12 in the given bracket as shown in figure. **[26]**

OR

Design & draw neat dimensional drawing in three views with one sectional view of Milling fixture for creating plane surface of ϕ 24mm of the given bracket as shown in figure.

Also Justify the selection of location, clamping & guiding elements.

) Attempt any two. **[6]**

a) Explain with neat sketch the Compound die. **[6]**

b) Explain types of Stock stop. **[6]**

c) Explain the importance of following in Press working

i) Strippers

ii) Clearanace

[12]

6) Write short notes any three.

a) Construction & working of CNC.

b) Automatic Tool Changer.

c) CNC axes and drives.

d) Modular Tooling System.

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Q6) a) Explain the step by step procedure for selection of V- belt from Manufacturer's Catalogue. [6]

b) It is required to select flat belt drive for a fan running at 360 rpm which is driven by a 10kW 1440 rpm motor. The belt drive is open type and space is available for a center distance of 2 m approximately. The belt should operate at velocity between 17.80 m/s to 22.90 m/s. The power transmitting capacity of the belt per mm width per ply at 180° arc of contact and at a belt velocity of 5.08 m/s is 0.0118 kW. The load correction factor can be taken as 1.2. Suggest preferred pulley diameters for the motor and fan pulleys and give complete specifications of belting. Refer the tables given below. [10]
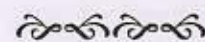
Arc of Contact Factor (F_d)

α_s(Deg)	130	140	150	160	170	180	190	200
F_d	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

Standard Widths of these belts in mm

3–Ply	25	40	50	63	76				
4–Ply	40	44	50	63	76	90	100	112	125	152
5-Ply	76	100	112	125	152				
6-Ply	112	125	152	180	200				

For flat pulleys: Series of preferred values of pitch diameters (in mm) are as follows.

Pitch diameter (mm):	125	132	140	150	160	170	180	
200	212	224	236	250	265	280	300	315	355	375
400	425	450	475	500	530	560	600	630	670	710
750	800	900	1000							

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Seat No.

T.E. (Mechanical) (Part - III) (Semester - V) (Revised)
Examination, November - 2017
MACHINE DESIGN - I
Sub. Code: 66244

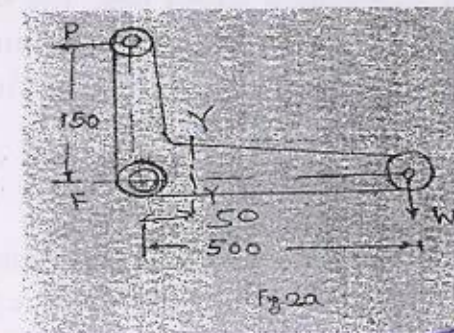Day and Date :Monday, 20 - 11 - 2017   Total Marks : 100
Time :10.00 a.m. to 1.00 p.m.

Instructions : 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Make suitable assumption wherever required and state them clearly.
4) Use of non-programmable calculator is permitted.
5) Draw neat diagrams wherever necessary.

Q1) Solve any Three: [18]
a) Summarize material selection procedure adopted for designing a machine element.
b) Name different theories of failure.Illustrate the use of theory of failure for brittle material.
c) Explain the design procedure for a turn-buckle with the help of neat sketch.
d) Write a note on design of bolted joints with load perpendicular to the axis of bolt.
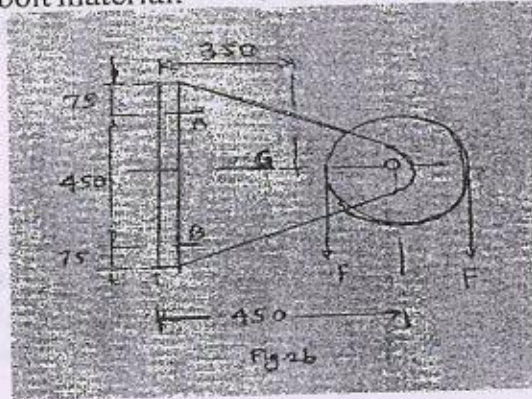
Q2) a) A bell crank lever to raise a vertical load is shown in fig 2a. The vertical load to be lifted is 4500N. The lever consists of forged steel material and a pin at the fulcrum F. Assume following data for the lever material.
Safe stress in tension = 75 MPa; safe stress in shear=60MPa; safe bearing pressure on pins=10N/mm². Determine the pin diameter at end P, dimensions at F and cross section Y-Y (near to fulcrum) [8]

Fig 2a

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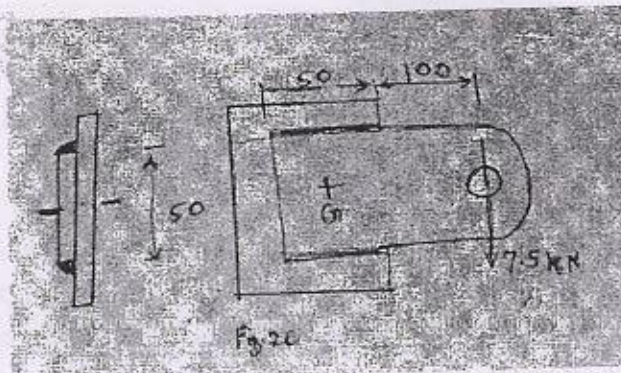
b) Figure 2b shows a pulley bracket, which is supported by 4 bolts, two at A and two at B. The weight of pulley and bracket, W is 1850N, and the load, F on the rope is 20kN.

Determine the size of the bolts, using an allowable shear stress of 40 MPa for the bolt material. [8]

Fig 2b

OR

c) A welded connection as shown in figure 2c is subjected to the eccentric force of 7.5 kN. Determine the size of welds if the permissible shear stress for the weld is 90N/mm². Assume static conditions. [8]

Fig 2c

Q3) a) Discuss the design procedure for square key. [6]

b) A splined connection with the following particulars is used for a gear and shaft assembly in a gear box. The power to be transmitted is 20kW at 240 r.p.m. The bearing pressure on the splines is limited to 6.5.MPa during sliding. The coefficient of friction is 0.1 [10]

Major diameter = 60mm

Minor diameter = 54 mm

Number of splines = 10

Determine (i) The length of gear hub

ii) The force required to shift the gear.

OR

-2-

c) Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used:

Shear stress for shaft, bolt and key material = 40MPa

Crushing stress for bolt and key = 80 MPa

Shear stress for cast iron = 8 Mpa

Draw a neat sketch of the coupling. [10]

Q4) a) What are the various types of springs used in practice? Explain one application of each. [6]

b) Design a close coiled helical compression spring for a service load ranging from 2245N to 2745N. The axial deflection of the spring for this load range is 6mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity is 84kN/mm². Assume squared and ground ends for coil. Neglect the effect of stress concentration. Draw fully dimensioned sketch of the spring.

Std. wire gauge (SWG) number and corresponding diameter of spring wire is given in the following table. [10]

SWG	6/0	5/0	4/0	3/0	2/0
Diam.mm	11.785	10.973	10.160	9.490	8.839

Q5) a) Derive an expression for maximum efficiency for square threaded screw.[6]

OR

What is recalculating ball screw? Explain with neat sketch.

b) The power transmission screw of a screw press is required to transmit maximum load of 100 kN and rotates at 60 RPM. The trapezoidal threads are to be used as under:

Nominal Dia. mm	40	50	60	70
Core Dia. mm	32.50	41.50	50.50	59.50
Mean Dia. mm	36.50	46.00	55.50	65.00
Core Area mm²	830	1353	2003	2781
Pitch mm	7	8	9	10

The screw thread friction coefficient is 0.12. The torque required for collar friction and journal bearing is about 10% of the torque to drive the load considering screw friction. Determine screw dimensions and its efficiency. Also determine the motor power required to drive the screw. The maximum permissible compressive stress in the screw is 100 MPa. [12]

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T.E. (Mechanical) (Part-III) (Semester-V) (Revised)
Examination, November - 2017
HEAT AND MASS TRANSFER
Sub. Code : 66243

Day and Date : Tuesday, 14-11-2017　　　　　　　Total Marks : 100
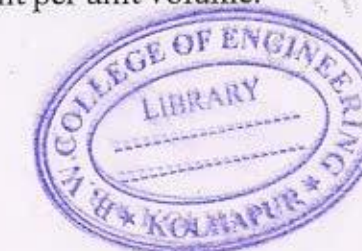Time : 10.00 a.m. to 1.00 p.m.

Instructions :　1)　All Questions are compulsory.
　　　　　　　2)　Figures to the right indicate full marks.
　　　　　　　3)　Assume Suitable Data wherever necessary and state it Clearly.
　　　　　　　4)　Use of scientific non programmable calculator is permitted.

Q1) Solve any three:

a)　Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow sphere.　　　　　　　　　　　**[6]**

b)　Explain the different modes of mass transfer. Explain with suitable examples.　　　　　　　　　　　　　　　　　　　　　　**[6]**

c)　A 0.8m high and 1.5m wide double pane window consist of two 4mm thick layer of glass (k = 0.78 W/mK) separated by 10mm wide stagnant air space (k = 0.0626 W/mK). Determine the rate of heat transfer through this window when room is maintained at 20°C and outside air is at -10°C. Take convective heat transfer coefficient as 10 and 40 W/m²K.　**[6]**

d)　An aluminum pipe carries steam at 110°C. The pipe (k = 185 W/mK) has an inner diameter of 10cm and outer diameter of 12cm. The pipe is located in a room where the ambient air temperature is 30°C and convective heat transfer coefficient is 15 W/m²K. Determine heat transfer rate per unit length of pipe. Neglect convective heat transfer on steam side.　　　　　　　　　　　　　　　　　　　　　　**[6]**

Q2) Solve any two:

a)　Derive expression for temperature distribution of a solid cylinder generating heat at the rate of q unit per unit volume.　　　　**[8]**

P.T.O.

b) Derive expression of temperature distribution for a solid body by using lumped heat capacity approach. [8]

c) A solid copper sphere of 10cm diameter (ρ = 8954 kg/m³, C_p = 383 J/kgK, k = 386 W/mK). Initially at uniform temperature 250°C, it suddenly immersed in a fluid which is maintained at uniform temperature of 50°C. The heat transfer coefficient between sphere and fluid is 200 W/m²K. Determine the temperature of copper sphere at 5 minutes after immersion. [8]

23) Solve any two:

a) Derive an expression for temperature distribution along the length a pin fin with insulated tip. [8]

b) A 1m long, 5cm diameter cylinder placed in an atmosphere of 40°C is provided with 12 fins (k = 75 W/mK), 0.75mm thick, The fins protrudes 2.5cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m²K. Calculate the rate of heat transfer if the surface temperature of cylinder is 150°C. [8]

c) Determine thermal conductivity of long solid 2cm diameter rod, 1 end of the rod is inserted in a furnace while remaining portion is projected out in air at 30°C. After steady state has been reached, the temperature at two points on the rod which are 10cm apart are measured and found to be 120°C and 90°C respectively. If heat transfer coefficient is 20 W/m²K. What will be thermal conductivity of the rod? [8]

24) Solve any two of the following:

a) With the help of dimensional analysis, analyze natural convection heat transfer problem. [8]

b) A vertical cylinder 1.5m high and 180mm in diameter is maintained at 100°C in an atmosphere environment of 20°C. Calculate heat loss by free convection from the surface of the cylinder. Assume properties of air at mean film temperature as, ρ= 1.06 kg/m³, γ= 18.97×10⁻⁶m²/s, C_p=1.004 kJ/kg°C and k=0.0285 w/m°C, Pr = 0.708. [8]
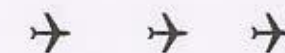
Use correlation; $Nu_L = 0.10 (Gr.Pr)^{1/3}$.

c) Air at a temperature of 20°C flows through a rectangular duct with a velocity of 10m/s. The duct is 30cm×20cm in size and air leaves at 34°C. Find the heat gain by air when it is passed through 10m long duct. The properties of air at 27°C are ρ=1.1774 kg/m³, γ= 15.68 10⁻⁶m²/s, C_p=1057 J/kgK and k=0.03003 W/mK, Pr = 0.708. [8]
Use correlation ; $Nu = 0.023 (Re)^{0.8} pr^{0.4}$.

25) Solve any two of the following:

a) Write a short notes on; [8]
   i) Shape factor and its properties
   ii) Radiation shield

b) Write plank's law and derive Stefan Boltzman law from Plank's law. [8]

c) The effective temperature of a body having an area of 0.12m² is 527°C.[8]
Calculate;
   i) The total rate of energy emission
   ii) The intensity of normal radiation
   iii) The wavelength of maximum monochromatic emissive power

26) a) Draw the temperature distribution curve for following heat exchangers (any 3) [6]
   i) Counter flow heat Exchanger
   ii) Evaporator
   iii) Parallel flow heat Exchanger
   iv) Condenser

b) What are the design considerations of heat exchangers? [6]

c) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5kg/s respectively. The inlet temperatures of hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If overall heat transfer coefficient is 325 W/m²⁰C, calculated the area of heat exchanger. Assume C_p of water 4.187 kJ/kgK. [6]

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b) The crank and the connecting rod of a 4 - cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1 - 4 - 2 - 3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine:

i) Unbalanced primary and secondary forces, if any, and

ii) Unbalanced primary and secondary couples with reference to central plane of the engine. [12]

OR

6) a) Derive expression for energy stored in a flywheel. [6]

b) A single cylinder double acting steam engine develops 150 kW at a mean speed of 80 rpm. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 metre and the hub and spokes provide 5 % of the rotational inertia of the flywheel, find the mass and cross-sectional area of the flywheel rim. Assume the density of the flywheel material as 7200 kg/m³. [10]

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Seat No. [ ]

T.E. (Mechanical Engineering) (Part - III) (Semester - V) (Revised) Examination, November - 2017
THEORY OF MACHINES - II
Sub. Code: 66242

Day and Date : Saturday, 11 - 11 - 2017   **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled sketch wherever necessary.
4) Assume if necessary suitable data and state clearly.
5) Use of Non programmable calculator is permitted.

Q1) a) Give the classification of Toothed Gearing and define the following terms.
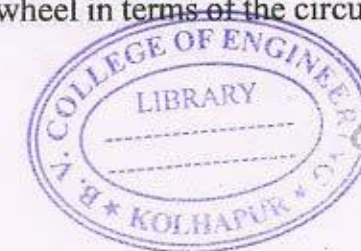
i) Addendum.

ii) Module. [8]

OR

Derive the expression for the velocity of sliding between pair of involute teeth and define the terms.

i) PitchCircle.

ii) Diametral Pitch.

b) A pair of Spur gears with involute teeth is to give a gear ratio of 4 : 1. The arc of approach is not to less than the circular pitch and smaller wheel is the driver. The angle of pressure is 14.5°. Find

i) the least number of teeth that can be used on each wheel and

ii) the addendum of the wheel in terms of the circular pitch. [10]

P.T.O.

2) a) What are the various types of the torques in an epicyclic gear train. [6]

OR

Explain the concept of equivalent mass and moment of inertia applied for gear trains.

b) Fig. 2 b shows an epicyclic gear train with compound planets 'B - C', 'B' has 15 teeth and meshes with an annulus 'A' which has 60 teeth. 'C' has 20 teeth and meshes with the sunwheel 'D' which is fixed. The annulus is keyed to the propeller shaft 'Y' which rotates at 740 rad/s. The spider which carries the pins upon which the planets revolve is driven directly from main gear box by shaft 'X', this shaft being relatively free to rotate with respect to wheel 'D'. Find the speed of shaft 'X', when all the teeth have same module. When engine develops the 130 kW, what is the holding torque on the wheel 'D'? Assume 100 percent efficiency throughout. [10]
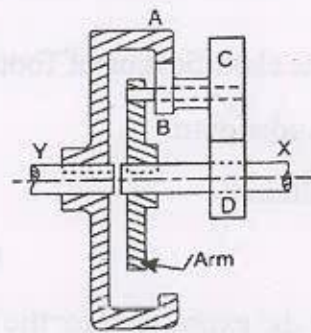

Fig. 2 b.

3) a) Condition for stability of two wheel vehicle moving in a curved path. [6]

b) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic couple in the following conditions.

i) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.

ii) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

iii) The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern. [10]

Q4) a) Derive the equation for inertia torque analytically considering the effect of inertia of the connecting rod. [6]

OR

Derive an expression for velocity and acceleration of the slider of slider crank mechanism.

b) In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The weight of the reciprocating parts is 120 kg and the stroke of the piston is 440 mm. The engine runs at 250 rpm. If the net load on the piston due to steam pressure is 25 KN when the crank has turned through an angle of 120° from the top dead centre, determine the

i) thrust in the connecting rod.

ii) pressure on the slide bars.

iii) tangential force on the crank pin.

iv) thrust on the bearings.

v) turning moment on the crank shaft. [10]

Q5) a) Explain balancing of single rotating mass by two masses rotating in different planes. [6]

OR

Explain direct and reverse crank method for balancing of radial engine.

24) a) Sketch root locus plot for $G(S)\,H(S) = \dfrac{K}{S(S^2+6.S+12)}$. **[12]**

b) A unity feedback control system is having an open loop transfer function

$G(S) = \dfrac{K(S+13)}{S(S+3)(S+7)}$. Determine the range of values of K for the system

to be stable. **[6]**

25) a) Sketch the Bode plot for the transfer function

$G(S) = \dfrac{1000}{S(1+0.1.S)(1+0.001.S)}$. Determine gain margin and phase

margin. **[10]**

b) Calculate break in point and angle of departure for the control system, given by characteristic equation $S^2 + 2S + 3 + K(S+2) = 0$. **[6]**

26) a) The motion of a numerically controlled machine tool is described by the differential equation $\ddot{y} + 7.\dot{y} + 10.y = f(t)$. Determine computer diagram and state space representation using parallel method. **[8]**

b) The motion of robot arm controlled by an electric motor is given by the differential equation $\ddot{y} + 6.\dot{y} + 9.y = f(t)$. Use series programming to determine computer diagram. **[8]**

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Seat No.

T.E. (Mechanical) (Semester - V) Examination, November - 2017
CONTROL ENGINEERING
Sub. Code : 66241

Day and Date : Thursday, 09 - 11 - 2017   Total Marks : 100
Time : 10.00 a.m. to 01.00 p.m.

Instructions :   1)   All questions are compulsory.
           2)   Figures to the right Indicates full marks.
           3)   Assume any additional data if required and mention it clearly.

Q1) a) For the mechanical system shown in Fig. 1 a, prepare grounded chair representation and construct electrical circuit using force current analog. **[6]**
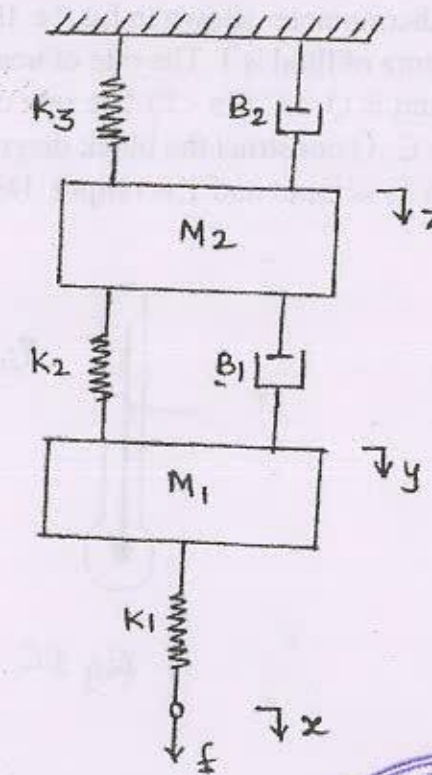
fig 1 a

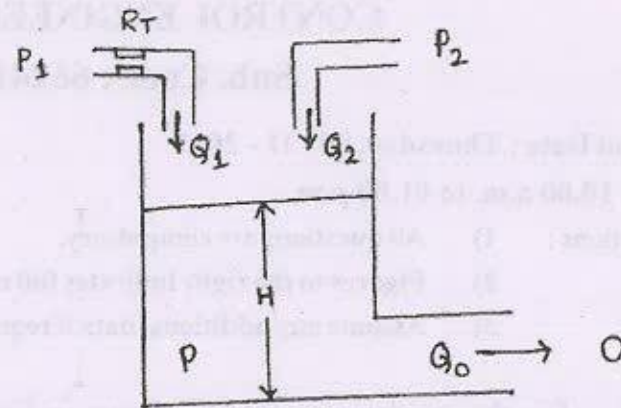b) For the fluid system shown in Fig. 1b, determine equation of P1 in terms of P2 and P. [6]

fig 1 b

c) For the thermometer shown in fig. 1c, the ambient temperature is Ts and temperature of fluid is T. The rate of heat flow from surrounding medium to the fluid is $Q = C_1(Ts - T)$ The rate of change of temperature of fluid is $D.T. = C_2.Q$ construct the block diagram representation for the system in which Ts is input and T is output. Determine time constant. [6]
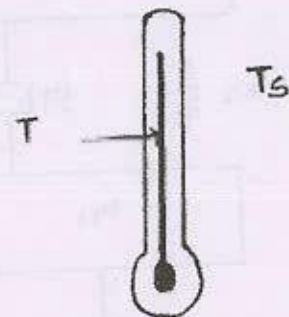

fig 1c

22) a) Determine linear approximation for the equation $Z = sinX. cos Y$ for $Xi = 60°$ and $Yi = 30°$, What is approximate value of Z when $X = 63°$ and $Y = 28°$. [8]

b) Reduce the block diagram shown in fig. 2b and obtain transfer function.[8]
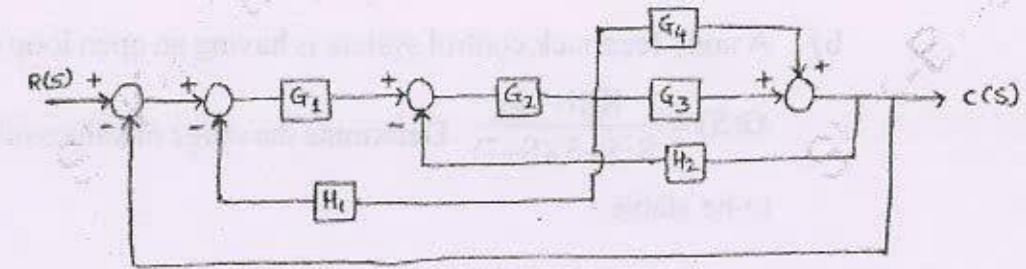

fig 2 b

23) a) A hydraulic control system is shown in fig. 3a. The forcing function is $r(t) = u(t)$ and all initial conditions are zero. Determine the response c(t) of system. [8]
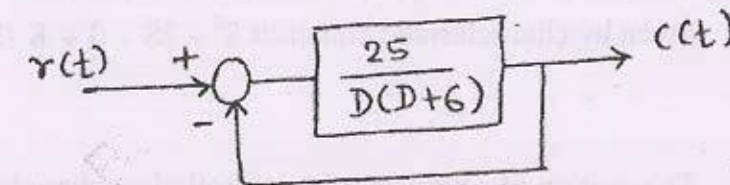

fig. 3 a

b) For the control system shown in fig. 3b, determine K_1, K_2 and a such that the system will have a steady state gain of 1, a natural frequency of 2 and damping ratio of 0.5. [8]
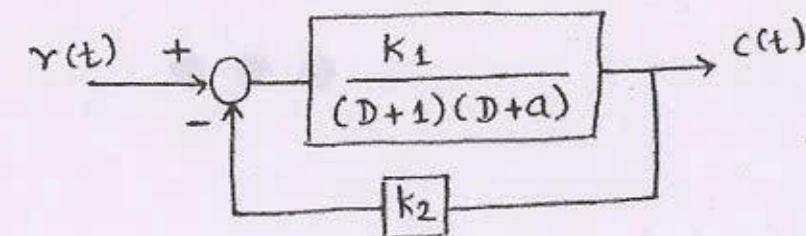

fig. 3 b

Seat
No.

T.E. (Mechanical Engg.) (Part - III) (Semester-VI)
Examination, November - 2017
MACHINE DESIGN - II
Sub. Code : 66840

Day and Date : Monday, 06-11-2017   Total Marks : 100
Time : 2.30 p.m. to 5.30 p.m.

Instructions :   1)   All questions are compulsory.
                  2)   Draw neat sketches whenever necessary.
                  3)   Figures to the right indicate full marks.
                  4)   Make suitable assumptions if necessary and state it clearly.

SECTION-I

Q1) a) Define stress concentration. What are causes and remedies over stress concentration?   **[8]**

OR

a)   Explain the following terms in relation with design of component subjected to fluctuating loads:

i)   Endurance limit

ii)   Surface finish factor

iii)   Size factor

iv)   Notch sensitivity

b)   A work cycle of a mechanical component subjected to completely reversed bending stresses consist of the following three elements: **[8]**

i) ± 350 N/mm² for 85% of time

ii) ± 400 N/mm² for 12% of time

iii) ± 500 N/mm² for 3% of time

The material for the component is 50C4 ($S_{ut} = 660$ N/mm²) and the corrected endurance limit of the component is 280 N/mm². Determine the life of the component.

P.T.O.

Q2) a) Explain the following terms in connection with roller bearing,   [8]

     i)   Static load capacity

     ii)   Dynamic load capacity

     iii) Equivalent load capacity

     iv) Load - life relationship

<div align="center">OR</div>

  a) Differentiate between static and dynamic capacity of the ball bearing. What is their significance in the selection of the bearings?

  b) A deep-groove ball bearing having bore diameter of 60 mm and rotating at 1440 r.p.m. is subjected to radial force of 2500N and an axial force of 1200 N. The radial and thrust factors are 0.56 and 2.0 respectively. The load factor is 1.2. The expected rating life is 25,000 hrs. Calculate the required dynamic load capacity and select the bearing from manufacturer's catalogue given below in table no. 1.   [8]

<div align="center">Table no.1</div>

Principal Dimensions				Basic Capacity	
Bearing No.	Bore Dia 'd' mm	Outside Dia 'D'mm	Width 'B' mm	Static 'Co' kN	Dynamic 'C' kN
6012	60	95	18	23.20	29.60
6212	60	110	22	32.50	47.50
6312	60	130	31	52.00	81.90
6412	60	150	35	69.50	108.00

Q3) a) Explain the following terms in relation to sliding contact bearings,   [8]

     i)   Length to diameter ratio

     ii)   Unit bearing pressure

     iii) Radial Clearance

     iv) Minimum film thickness

<div align="center">OR</div>

a) With neat sketches, describe construction and working principles of hydrodynamic bearings.

b) The following data is given for a 360° hydrodynamic bearing. **[10]**

Radial load = 3.2kN

Journal speed = 1490 rpm

Journal diameter = 50 mm

Bearing length = 50 mm

Radial clearance = 0.05 mm

Viscosity of lubricant = 25 cp

Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate

i) Coefficient of friction

ii) Power lost in friction

iii) Minimum oil film thickness

iv) Flow requirement in litres/min

v) Temperature rise

Refer following data table:

l/d	ε	h_0/C	S	ϕ	$(r/C)f$	$Q/(rCn_s l)$
	0.1	0.6	0.264	63.10	5.79	3.99
	0.6	0.4	0.121	50.58	3.22	4.33
1	0.8	0.2	0.0446	36.24	1.70	4.62
	0.9	0.1	0.0188	26.45	1.05	4.74
	0.97	0.03	0.0047	15.47	0.514	4.82

SECTION - II

Q4) a) Explain different types of gear tooth failure. **[8]**

OR

a) Explain the force analysis in the design of spur gears.

b) It is required to design a pair of spur gears with 20° full-depth involute teeth consisting of a 20-teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm electric motor. The starting torque of the motor can be taken as 150% of the rated torque. The material of the pinion is plain carbon steel Fe410 (S_{ut} = 410 N/mm^2), while the gear is made of grey cast iron FG 200 (S_{ut} = 200 n/mm^2). The factor of safety is 1.5. Design the gears based on the Lewis equation and using velocity factor to account for the dynamic load. Lewis form factors for 20 and 50 teeth are 0.32 and 0.408 respectively. Assume pitch line velocity as 5 m/s. Recommended series of module: 7 or 9. [8]

Q5) a) Derive expression for wear strength of helical gears. [8]

OR

a) Explain with neat sketch the concept of virtual number of teeth and its significance in the design of helical gear.

b) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 40 teeth gear. The helix angle is 25° and the normal pressure angle is 20°. The normal module is 3mm. Calculate [10]
   i) The transverse module
   ii) The transverse pressure angle
   iii) The axial pitch
   iv) The pitch circle diameters of the pinion and the gear
   v) The centre distance and
   vi) The addendum and dedendum circle diameter of the pinion

Q6) a) Explain with neat sketch the force analysis of bevel gear. [8]

OR

a) Explain the strength rating of worm gearing.

b) A pair of worm gears is designated as 1/30/10/8 Calculate [8]
   i) The centre distance
   ii) The speed reduction
   iii) The dimensions of the worm and
   iv) The dimensions of the worm wheel

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Seat
No.

T.E. (Mechanical) (Part - III) (Semester - VI) (New) (Revised) Examination, November - 2017
INTERNAL COMBUSTION ENGINES
Sub. Code: 66841

Day and Date : Tuesday, 07 - 11 - 2017   **Total Marks : 100**
Time : 2.30 p.m. to 5.30 p.m.

Instructions :   1)   Attempt all the questions.
                  2)   Make suitable assumptions if necessary and clearly mention them.
                  3)   Figure to right indicate full marks.

Q1) a)   Define the following terms   **[8]**
          i)   Clearance volume.
          ii)   Swept volume.
          iii) Thermal efficiency.
          iv)   Air standard efficiency.

                                    OR

     b)   Classify IC Engine and explain each type with examples.   **[8]**
     c)   Explain with neat sketch port timing diagram for two stroke petrol engine.
                                                                                [8]

Q2) a)   A four cylinder, four stroke square engine running at 40 rev/sec has a carburetor venturi with a 3 cm throat. Assuming the bore to be 10 cm, volumetric efficiency of 75%, the density of air to be 1.15 kg/m³ and coefficient of air flow to be 0.75. Calculate,   **[9]**
          i)   Engine volume sucked per second and mass flow rate.
          ii)   Suction pressure at throat.

     b)   Explain the following terms.   **[9]**
          i)   Air fuel ratio and its types.
          ii)   Air fuel requirements for SI engine.
          iii) Petrol injection in SI engine.

                                    OR

     c)   Explain the injection nozzles used in CI engine and its types.   **[9]**

P.T.O.

Q3) a) Write types of combustion chamber for SI engine and explain requirements of Combustion chamber. **[8]**

OR

b) Explain the factors influenced of engine variable on flame speed. **[8]**

c) Explain the effect of various engine variables on detonation. **[8]**

Q4) a) What modification is required, if the existing engine is to be supercharged? What are various methods of turbo charging? **[8]**

b) Explain with figure abnormal combustion in CI engine. Discuss for the control of knocking for CI engine. **[8]**

Q5) a) Discuss the various pollution norms and devices used for the control of engine emissions. **[8]**

b) What do you mean by induction swirl in combustion chamber of C I Engines? Discuss the advantages and disadvantages of the induction swirl. **[8]**

OR

b) What are the different methods to measure frictional power of ic engines. Explain Morse test. **[8]**

Q6) a) List the advanatges and disadvantages of supercharging of diesel engine. **[7]**

OR

a) Describe the sources for the production of Biodiesel and its advantages for utilization in IC engines. **[7]**

b) A four stroke petrol engine develops 50 kW and consumes 16 liters of petrol per hour of specific gravity 0.755. The calorific value of fuel used is 44500kJ/kg. Find its indicated thermal efficiency. If engine runs at 3000 rpm. It develops the mean effective pressure of 5.2 bar. Determine the bore and length of stroke if stroke length is 1.1X bore. **[7]**

c) Write notes on HC Emission and their control. **[4]**

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