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Total No. of Pages : 2

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T.E. (Mechanical) (Semester - VI) (Revised)

Examination, May - 2018

INDUSTRIAL FLUID POWER

Sub. Code : 66838

Day and Date : Saturday, 05 - 05 - 2018

Total Marks : 100

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

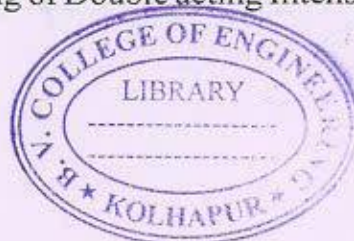
- Instructions :**
- 1) All questions are compulsory.
 - 2) Make suitable assumptions if required and state it clearly.
 - 3) Draw neat diagrams/sketches wherever necessary.
 - 4) Figures to the right indicate full marks.

Q1) Solve any two:

- a) Differentiate between hydraulics and pneumatics. [7]
- b) List applications of fluid power systems. [7]
- c) Draw the symbols for the following elements: [7]
 - i) Sequence Valve.
 - ii) Four way, three position-open centre pilot operated D. C. valve.
 - iii) Muffler.
 - iv) Single acting intensifier.
 - v) Single acting spring return actuator.
 - vi) Twin pressure valve.
 - vii) Air motor.

Q2) Solve any three:

- a) What is the difference between a fixed displacement pump and a variable displacement pump? Draw a neat sketch of balanced vane pump. [6]
- b) Mention the different types of mountings used in fixing the hydraulic cylinders. [6]
- c) What are the important locations of filters? Explain the advantages and disadvantages of each location. [6]
- d) Explain with neat sketch working of Double acting Intensifiers. [6]



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Q3) Solve any three:

- a) Explain different actuation mechanisms for D.C. valve in hydraulic systems. [6]
- b) Draw schematically a Pressure reducing valve and explain its working. [6]
- c) Explain the working of Pressure compensated flow control valve with neat sketch. [6]
- d) Explain the requirements of pressure control, direction control and flow control valves used in hydraulic systems. [6]

Q4) Solve any three:

- a) Compare air motor with electric motor. [6]
- b) With the help of neat sketch explain the working of air lubricator. [6]
- c) Explain with the help of neat sketch the construction and working of time delay valve. [6]
- d) Explain the working of 4/2 seat type Direction control valve with a neat sketch. [6]

Q5) Solve any three:

- a) Explain rapid traverse and feed circuit in hydraulic system. [6]
- b) Explain the Meter-in circuit used in hydraulic system. [6]
- c) With the aid of circuit diagram explain the working principle of impulse operation circuit in pneumatics. [6]
- d) Explain sequence circuit of type A+B+ A-B- in pneumatic system. [6]

Q6) Solve any two:

- a) Explain Hydraulic servo system for linear motion with neat sketch. [7]
- b) Explain Troubleshooting of Pneumatic system. [7]
- c) What is general principle of fluidic gate? Explain proportional amplifier. [7]



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- b) Explain the different methods of gear lubrication system. [7]
- c) Design a pair of spur gears with 20° full depth involute teeth consist of 17 teeth pinion meshing with 68 teeth gear. The module and face width are 2.5 and 25 mm respectively. The gears are machined to meet the specification of grade 10 and heat treated to surface hardness of 250 BHN. For grade 10, $e = 32 + 2.5 (m + 0.25 \sqrt{d})$ in μm . Use M.F.Spotts approach for the dynamic load. Determine: [11]
- The optimum speed for maximum power transmitting capacity.
 - The optimum power transmitted by the gears at the above speed.

- Q5) a) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20° and the helix angle is 25° . The normal module is 4 mm and the face width is 40 mm. The pinion and the gear is made of steel 40C8 ($S_u = 600 \text{ N/mm}^2$) and heat treated to a surface hardness of 300 BHN. The service factor and factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears. Use Y for 26 teeth = 0.344 and Y for 27 teeth = 0.348. [10]

OR

- b) A pair of straight tooth bevel gears has a velocity ratio 2:1. The pitch circle diameter of the pinion is 80 mm at large end of the tooth. 5 KW power is supplied to the pinion, which rotates at 800 rpm. The face width is 40 mm and the pressure angle is 20° . Determine the tangential, radial and axial components of resultant tooth force acting on the pinion. [10]
- c) Explain with the help of neat sketch force analysis of helical gear. [6]
- Q6) a) Explain with neat sketch the following terms in reference to bevel gears. [8]
- Pitch cone
 - Pitch angles for pinion and gear
 - Cone distance
 - Cone distance

OR

- b) Discuss the thermal consideration in the design of worm and worm wheel drive. [8]
- c) A pair of worm gear is designated as 1/40/10/4 has an effective surface area of 0.25 m^2 . A fan is mounted on the worm shaft to circulate air over the surface of the fins. The coefficient of heat transfer can be taken as $25 \text{ W/m}^2\text{C}$. The permissible temperature rise of the lubricating oil above the atmospheric temperature is 45°C . The coefficient of friction is 0.035. The worm shaft is rotating at 1440 rpm and the normal pressure angle is 20° . Calculate the power transmitting capacity based on thermal considerations. [8]

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T.E. (Mechanical) (Semester - VI) (Revised)
Examination, May - 2018
MACHINE DESIGN - II
Sub. Code :66840

Day and Date : Saturday, 12- 5 - 2018
 Time :2.30 p.m. to 5.30 p.m.

Total Marks : 100

- Instructions : 1) Figures to the right indicate full marks.
 2) Assume suitable data wherever necessary.
 3) Use of Non - programmable calculator is allowed.

- Q1) a) Draw Soderberg and Goodman fatigue diagram. Explain its significance. [8]

OR

- a) Describe the process of fatigue design under combined stresses. [8]
- b) A machine shaft carries a pulley between two bearings. The bending moment at the pulley varies from 200 N-m to 600 N-m and the torsional moment in the shaft varies from 70 N-m to 200 N-m. The frequencies of variation of bending and torsional moments are equal to the shaft speed. The shaft is made of steel FeE 400 ($S_u = 540 \text{ N/mm}^2$ and $S_y = 400 \text{ N/mm}^2$) and the corrected endurance strength of shaft is 200 N/mm^2 . Determine the diameter of the shaft using factor of safety of 2. [10]

- Q2) a) Explain 'Stiffening factor' in design of plastics. What are various ways of stiffening in plastics? [6]

OR

- a) Explain significance of DFM and its effect on design quality. [6]
- b) A single row deep groove ball bearing No. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. Use Table 1 for data. [10]

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Principal Dimensions (mm)			Basic Load Ratings (N)		Designation
d	D	B	C	Co	
10	19	5	1480	630	61800
	26	8	4620	1960	6000
	30	9	5070	2240	6200
	35	11	8060	3750	6300
15	24	5	1560	815	61802
	32	9	5590	2500	6002
	35	11	7800	3550	6202
	42	13	11400	5400	6302
20	32	7	2700	1500	61804
	42	8	7020	3400	16404
	42	12	9360	4500	6004
	47	14	12700	6200	6204

Table 1 : Parameters for Single - row deep groove ball bearings.

$\left(\frac{F_a}{C_0}\right)$	$\left(\frac{F_a}{F_r}\right) \leq e$		$\left(\frac{F_a}{F_r}\right) > e$		
	X	Y	X	Y	
0.025	1	0	0.56	2.0	0.22
0.040	1	0	0.56	1.8	0.24
0.070	1	0	0.56	1.6	0.27
0.130	1	0	0.56	1.4	0.31
0.250	1	0	0.56	1.2	0.37
0.500	1	0	0.56	1.0	0.44

Table 2: X and Y factors

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Q3) a) Derive Striback's Equations. [8]

OR

a) What are the various Tribological considerations used in design of bearings. [8]

b) A following data is given for a 360° hydrodynamic bearing. [8]

Journal diameter = 100 mm

Bearing length = 100 mm

Radial load = 50 KN

Journal speed = 1440 rpm

Radial clearance = 0.12 mm

Viscosity of lubricant = 16Cp.

Calculate:

i) Minimum oil film thickness

ii) Coefficient of friction

iii) Power lost in friction

Refer following data Table:

l/d	ϵ	h_0/C	S	ϕ	$(f/C)f$	$Q/(rCn, l)$
1	0.4	0.6	0.264	63.10	5.79	3.99
	0.6	0.4	0.121	50.58	3.22	4.33
	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

Q4) a) Explain the term static and dynamic loads on gear tooth. Describe various parameters which contribute dynamic load. [7]

OR

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

Strategies	Events		
	E ₁	E ₂	E ₃
S ₁	8000	70000	50000
S ₂	50000	45000	40000
S ₃	25000	10000	0

What will be your decision under the following approaches:

- Optimistic Criterion
 - Pessimistic Criterion
 - Laplace Criterion
 - Hurwicz Criterion ($\alpha = 0.4$)
- c) Draw the project network for the following activities and determine critical path and project duration.

Activity	Preceding activity	Duration (days)
A	-	16
B	A	18
C	B	14
D	A	30
E	C, D	8
F	E	2
G	D	8
H	E, G	10
I	H, F	8

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

Machines	Jobs							
	J1	J2	J3	J4	J5	J6	J7	J8
M1	5	4	22	16	15	11	9	4
M2	6	10	12	8	20	7	2	21

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T.E. (Mechanical) (Part - III) (Semester - VI) (Revised)
Examination, May - 2018
INDUSTRIAL MANAGEMENT & OPERATIONS
RESEARCH
Sub. Code: 66837

Day and Date : Thursday, 03 - 05 - 2018
 Time : 2.30 p.m. to 5.30 p.m.

Total Marks : 100

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

Q1) Attempt any four:

[20]

- Explain in brief principle of organizing.
- What is the selection process followed in public sector undertakings?
- Prepare a suitable plan of training to fresh engineering graduates for a large scale manufacturing concern.
- Discuss the relationship between leadership, motivation & productivity.
- How does Herzberg's theory of motivation differs from Maslow's theory of motivation?

Q2) Attempt any two:

[12]

- What factors are studied in conducting feasibility report writing of any proposed business activity?
- How market assistance is rendered by government to small scale industries?
- Explain positive and negative impact of globalization on small scale industries in India.



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[18]

Q3) Write short notes on any three:

- Difference between Marketing & selling concept.
- Types of Advertising.
- Objectives of Purchasing.
- Evaluation of Purchase Performance.
- Cost control and Cost reduction.

Q4) Attempt any three:

[18]

- What is a Operations Research model? Discuss the advantages of limitation of good Operations Research model.

- Use Graphical method to solve the following:

$$\text{Maximize } Z = 9X_1 + 4X_2$$

Subjected to constraints,

$$7X_1 + 5X_2 \leq 70,$$

$$4X_1 + 6X_2 \leq 48$$

$$3X_1 + 6X_2 \leq 42$$

$$X_1, X_2 \geq 0$$

- A sheet metal operation company manufactures four models of tray. Each tray is first cut on cutting process in the trimming shop and next sent to the soldering shop where edges are joined. The average time in minutes for each job in these shops is as follows:

Shop	Tray A	Tray B	Tray C	Tray D
Trimming shop	2	2	3	4
Soldering shop	4	6	7	8

Because of limitations in capacity of the plant, no more than 700 minutes/day of capacity is expected in Trimming shop and 1400/day minutes of capacity is expected in the soldering shop in the next six months. The contribution from sales for each tray is as given below: Tray A : Rs. 12/- per unit, Tray B : Rs. 12/- per unit, Tray C : Rs. 12/- per unit and Tray D : Rs. 12/- per unit. Formulate LPP. Suggest suitable method for solution to LPP.

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

$$\begin{aligned} \text{Minimise } Z &= 6X_1 + 5X_2 + 4X_3 \\ \text{Subjected to constraints } 6X_1 + 5X_2 + 10X_3 &\leq 76 \\ 8X_1 + 3X_2 + 6X_3 &\leq 50 \\ X_1, X_2, X_3 &\geq 0 \end{aligned}$$

Q5) Attempt any two:

[14]

- Indicate how you will test for optimality of initial feasible solution of a transportation problem.
- The unit transportation cost along with capacity and requirements from a factories to a warehouses is as given below:

Factory	Warehouse				Capacity
	1	2	3	4	
A	11	13	17	14	500
B	16	18	14	10	600
C	21	24	13	10	800
Requirements	400	450	550	600	

Obtain initial basic feasible solution by least cost method & VAM.

- A company has four workers and five jobs. Time taken by each worker to complete each job in minutes machine given in the matrix below. Solve the assignment problem & estimate the total time to complete all jobs.

Worker	Jobs				
	A	B	C	D	E
1	20	22	8	4	16
2	14	22	20	28	24
3	10	12	18	24	18
4	26	30	22	20	14

Q6) Write short notes on any three:

[18]

- Discuss the difference between decision under certainty, under uncertainty and under risk.

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T.E. (Mechanical) (Part - III) (Semester - VI) (New) (Revised)
Examination, May - 2018
INTERNAL COMBUSTION ENGINES
Sub. Code : 66841

Day and Date : Tuesday, 15 - 05 - 2018
Time : 2.30 p.m. to 5.30 p.m.

Total Marks : 100

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

Q1) a) Define the following terms. [8]

- i) Volumetric Efficiency.
- ii) Square Engine.
- iii) Stroke.
- iv) Compression ratio.

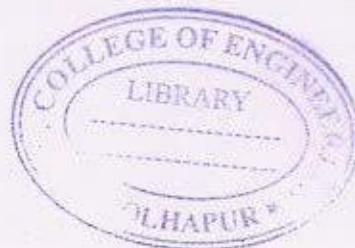
OR

- b) Classify IC Engine and explain each type with examples. [8]
- c) Explain with neat sketch valve timing diagram for high speed petrol engine. [8]

Q2) a) A simple jet carburetor is required to supply 4kg of air and 0.5 kg of fuel per minute. The Specific gravity of fuel is 0.75 and density of fuel is 750 kg/m³, the air is initially at 1 bar and 300 k, Determine [9]

- i) The throat diameter of choke for a flow velocity of 100 m/s.
- ii) If velocity coefficient is 0.8, the coefficient of discharge for the fuel nozzle is 0.60, and Pressure drop across metering orifice is 0.80 of that of choke, calculate orifice diameter.

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- b) What are the modern systems added in simple carburetor to become a complete Carburetor. [9]

OR

- c) Explain solid injection system for CI engine and its types. [9]

- Q3) a) Explain stages of combustion in SI engine with P- ϕ diagram. [8]

OR

- b) Explain the following terms for SI engine. [8]

- i) Ignition lag.
- ii) Flame propagation.
- iii) Octane number.
- iv) HVCr.

- c) What are the design requirements of SI engine combustion chamber? Explain any two types of combustion chambers. [8]

- Q4) a) Explain the design considerations of CI engine combustion chambers. List the types of indirect combustion chambers. [8]

- b) Compare between Induction swirl and compression swirl of CI engines. [8]

- Q5) a) Explain the effects of engine variables on 'Delay period' as referred to CI engines and its importance. [8]

- b) Compare abnormal combustion in CI Engines with SI Engines. [8]

OR

- b) What are the various requirements of fuel injections stem for Diesel engines. [8]

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- Q6) a) List the types of superchargers used and their advantages for diesel engine. [7]

- b) In morse test with a four cylinder four stroke petrol engine the following data were observed for a particular speed setting.
BHP with all cylinder cut out = 32.0, BHP with No.1 cylinder cut out = 21.6, BHP with No.2 cylinder cut out = 22.3, BHP with No.3 cylinder cut out = 22.5, BHP with No.4 cylinder cut out = 23.0, Estimate the IHP of the engine and mechanical efficiency. [7]
- c) Write note on Catalytic convertors. [4]



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T.E. Mechanical (Semester - V) Examination, April - 2018

CONTROL ENGINEERING

Sub. Code : 66241

Day and Date : Tuesday, 24 - 04 - 2018

Total Marks : 100

Time : 10.00 a.m. to 01.00 p.m.

- Instructions :
- 1) All questions are compulsory.
 - 2) Figures to the right indicate full marks.

- Q1) a) For the mechanical system shown in figure 1a, construct grounded chair representation and find equation relating f & x . [6]

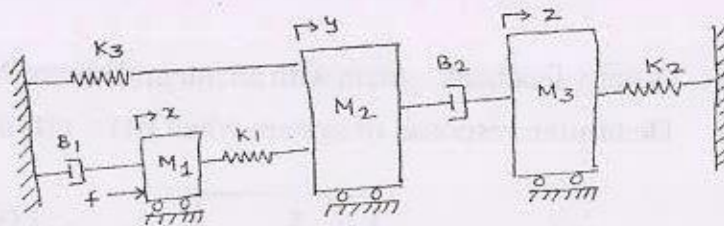


fig. 1 a

- b) For the electrical circuit shown in figure 1b, construct mechanical system using direct analog. [6]

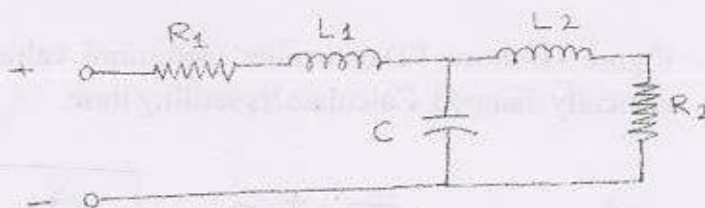


fig. 1 b

- c) Obtain mathematical model of rotational system shown in figure 1c. [6]

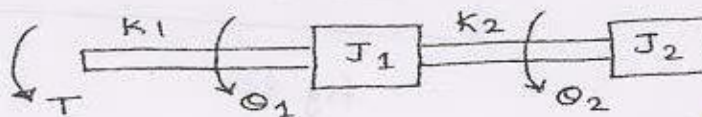


fig. 1 c



- 2) a) Determine linear approximation for the equation used to find area of right angle triangle. Use this approximation to calculate approximate area when height (H) and base (B) of right angle triangle is 10 units and 5 units respectively. Take $H_i = 12$ and $B_i = 4$. [8]
- b) Reduce the block shown in figure 2b and obtain transfer function. [8]

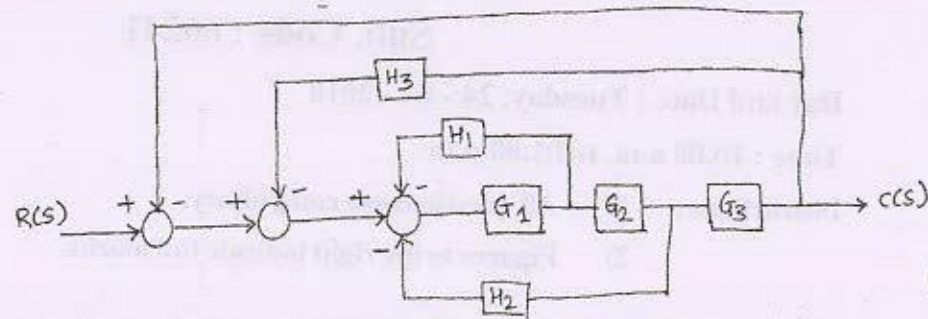


fig. 2 b.

- 3) a) A unity feedback system with an integral controller is shown in figure 3a. Determine response of system when $r(t) = u(t)$ and $c(0) = \dot{c}(0) = 0$ [8]

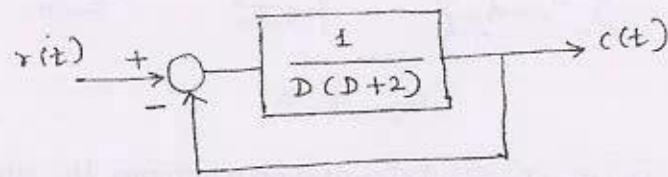


fig. 3 a.

- b) Figure 3 b shows PD controller. Determine value of T_d so that system is critically damped. Calculate its settling time. [8]

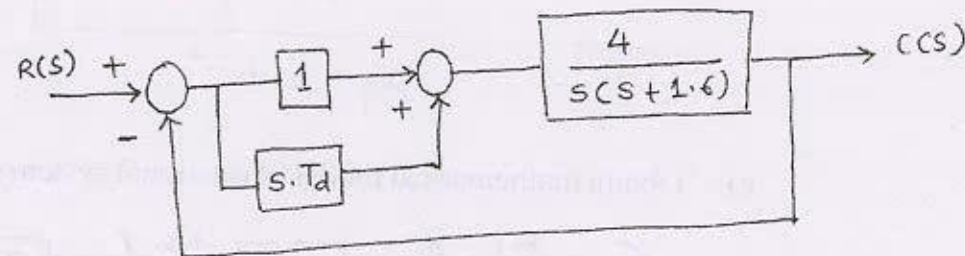


fig. 3 b.

- 4) a) The characteristics equation of a feedback system is $s^4 + 20s^3 + 15s^2 + 2s + k = 0$. Find value of k if [6]
- System is marginally stable and
 - System is in stable condition.

- b) Obtain root locus for a unity feedback system with open loop transfer function [10]

$$G(s) = \frac{k}{s(s^2 + 6s + 25)}$$

- 5) a) Determine value of k and α , so that unity feedback system oscillates at a frequency of 2 rad / sec. The system has open loop transfer function [8]

$$G(s) = \frac{k(s+1)}{s^3 + \alpha s^2 + 2s + 1}$$

- b) Draw Bode plot $G(s) = \frac{100(s+1)}{(s+10)(s+100)}$ [10]

- 26) a) A system is represented by $\frac{c(t)}{r(t)} = \frac{D+4}{D^2+4D+3}$, construct computer diagram and state space representation using direct programming. [8]

- b) Obtain state space representation and computer diagram using parallel programming for the system having transfer function [8]

$$\frac{c(t)}{r(t)} = \frac{D+5}{(D+1)(D+2)(D+3)}$$



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T.E. (Mechanical Engineering) (Part-III) (Semester - V)
(Revised) Examination, April - 2018
THEORY OF MACHINES - II
Sub. Code : 66242

Day and Date : Wednesday, 25 - 4 - 2018
 Time : 10.00 a.m. to 1.00 p.m.

Total Marks : 100

- 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) Derive an expression for the centre distance for a pair of spiral gears and define the following terms. [8]

- i) Normal pitch
- ii) Axial pitch

OR

Prove that the condition for maximum efficiency in case of spiral gear is $\alpha = \frac{\theta + \phi}{2}$ where, ϕ - friction angle, θ - shaft angle and α - spiral angle on the driving wheel.

- b) Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find the maximum velocity of sliding. [10]

Q2) a) Explain the working of Differential gear of an automobile. [6]

OR

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



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- b) Fig. 2 b shows an epicyclic gear train. Gear 'A' is fixed to the frame and is therefore stationary. The arm 'B' and gear 'C' and 'D' are free to rotate on the shaft. Gears 'A', 'C' and 'D' have 100, 101 and 99 teeth respectively. Pitch circle diameters of all are the same so that the planet gear 'P' meshes with all of them. Determine the revolutions of gears 'C' and 'D' for a revolution of the arm 'B'. [10]

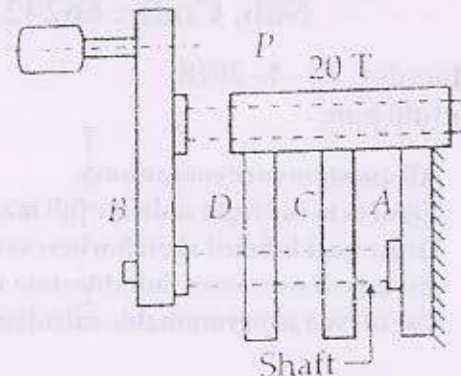


Fig. 2 b.

- 23) a) Derive the expression for gyroscopic couple magnitude. [6]
 b) A two wheeler of 400 mm wheel radius is negotiating a turn of radius 60 m at speed of 100 km/h. The combined mass of vehicle with its rider is 300 kg. The C.G. of rider is 0.6 m above ground level. The mass moment of inertia of engine flywheel is 0.3 kg-m^2 and moment of inertia of each road wheel is 1 kg-m^2 . If the speed of the engine is five times the speed of the wheel and in the same direction, find the angle of heel of vehicle. [10]
- 24) a) Derive an expression for velocity and acceleration of the slider of slider crank mechanism. [6]

OR

Explain dynamically equivalent system to replace connecting rod by a two mass system.

- b) The connecting rod of a vertical reciprocating engine is 2 m long between centres and weighs 250 kg. The mass centre is 800 mm from the big end bearing. When suspended as a pendulum from the gudgeon pin axis, it makes 8 complete oscillations in 22 seconds. Calculate the radius of gyration of the rod about an axis through its mass centre. The crank is 400 mm long and rotates at 200 rpm. Find the inertia torque exerted on the crankshaft when the crank has turned through 40° from the top dead centre and the piston is moving downwards. [10]

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- 5) a) Explain direct and reverse crank method for balancing of the radial engine. [6]

OR

Explain what is multi cylinder inline engine. Also explain conditions to have primary and secondary forces and couple balancing in multi cylinder in line engine.

- b) Four masses A, B, C and D as shown below are to be balanced. [12]

	A	B	C	D
Mass (kg)	--	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90° . B and C makes angles of 210° and 120° respectively with D in the same sense.

Find:

- i) The magnitude and the angular position of mass A, and
 ii) The positions of planes A and D.

- 26) a) Explain maximum fluctuation of energy and coefficient of fluctuation of energy. [6]
 b) The turning moment diagram for a multi cylinder engine has been drawn to a scale $1 \text{ mm} = 600 \text{ N-m}$ vertically and $1 \text{ mm} = 3^\circ$ horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows:
 $+52, -124, +92, -140, +85, -72$ and $+107 \text{ mm}^2$, when the engine is running at a speed of 600 rpm. If the total fluctuation of speed $\pm 15\%$ of the mean, find the necessary mass of the flywheel of radius 0.5 m. [10]



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Total No. of Pages : 3

T.E. (Mechanical) (Semester - V) (Revised)
Examination, April - 2018
MANUFACTURING ENGINEERING (Paper - III)
Sub. Code: 66245

Day and Date : Saturday, 28 - 04 - 2018

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) Draw neat sketch of a Single point cutting tool and explain different angles provided on single point cutting tool. [8]
- b) Explain Orthogonal & Oblique Cutting Operation with neat sketch. [8]
- c) During orthogonal turning operation of, following observations were made. Cutting force (F_h) = 15 Kg, Feed force (F_v) = 6 Kg, Rake angle (α) = 10° , Feed (t_f) = 0.2 mm, Chip thickness (t_c) = 0.4 mm. Cutting Speed (V) = 60 m/min. Find out : [8]
 - i) Shear angle.
 - ii) Workdone in shear and
 - iii) Shear strain.

Q2) Solve the following questions :

- a) Explain concept of Heat generation in metal cutting & use of coolants. [8]

OR

- a) Explain with sketch various types of drill. [8]
- b) The tool life of a Single point cutting tool is 10 minutes when it is operated at 240 m/min. At what speed it should be operated in order to have a tool life of 180 minutes. Assume $n = 0.3$. [8]

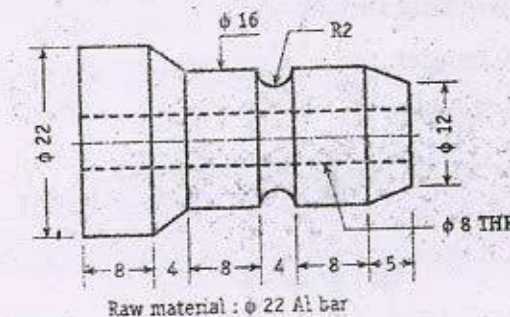
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Q3) The component shown in fig. is to be processed on a single spindle automat. Study the component and prepare : [18]

- a) Detailed process sheet.
- b) Tool Layout.
- c) Cam profile for drilling operation $\phi 8$ through
- d) Calculate Production rate per hour.



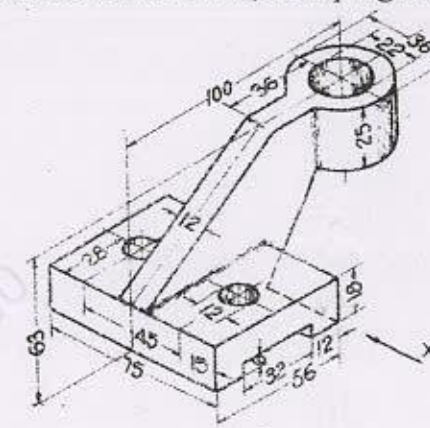
Material - Al bar of $\phi 22$. All dimensions are in mm.

SECTION - II

Q4) Design & draw neat dimensional drawing in three views with one sectional view of jig for drilling two holes $\phi 12$ as shown in figure. [26]

OR

Design & draw neat dimensional drawing in three views with one sectional view of Milling fixture for face milling of $\phi 36$ to maintain the height of 25 mm. Also Justify the selection of location, clamping & guiding elements.



Q5) Solve any two :

- a) Explain with sketch nomenclature of Press Tool. [6]
- b) Write design considerations for die element. [6]
- c) Explain different types of strippers. [6]

Q6) Write short notes on any three :

[12]

- a) Construction & working of CNC.
- b) Automatic Tool Changer.
- c) Modular Tooling System.
- d) Comparison between NC and CNC machines.



Seat No.	
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T.E. (Mechanical) (Part-III) (Semester - V) (Revised)**Examination, April - 2018****HEAT AND MASS TRANSFER****Sub. Code : 66243****Day and Date : Thursday, 26 - 04 - 2018****Total Marks : 100****Time : 10.00 a.m. to 1.00 p.m.**

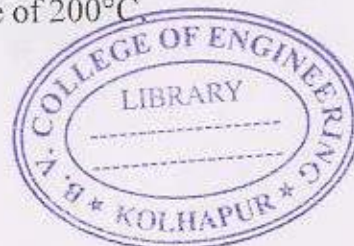
- Instructions :**
- 1) All questions are compulsory.
 - 2) Figures to the right indicate full marks.
 - 3) Assume Suitable Data wherever necessary and state it Clearly.
 - 4) Use of scientific non programmable calculator is permitted.

Q1) Solve any three:

- a) Define critical radius of insulation. Also derive the equation for critical radius of insulation for hollow cylinder. [6]
- b) What are the modes of mass transfer? Explain Fick's law of diffusion. [6]
- c) Air at 90°C flows in a copper tube ($k = 384 \text{ W/mK}$) of 4 cm inner diameter and with 0.6 cm thick walls which are heated from the outside by water at 125°C. A scale of 0.3 cm thick is deposited on outer surface of the tube whose thermal conductivity is 1.75 W/mK. The air and water side heat transfer coefficients are 221 and 3605 W/m²K, respectively. Find overall heat transfer coefficient on the outside area basis. [6]
- d) A steam pipe is covered with two layers of insulation. The inner layer ($k = 0.17 \text{ W/mK}$) is 30 mm thick and the outer layer ($k = 0.093 \text{ W/mK}$) is 50 mm thick. The pipe is made of steel ($k = 58 \text{ W/mK}$) and has inner diameter and outer diameter of 160 and 170 mm, respectively. The temperature of saturated steam is 300°C and The ambient air is at 50°C. If the inside and outside heat transfer coefficients are 30 and 5.8 W/m²K, respectively, calculate the rate of heat loss per unit length of pipe. [6]

Q2) Solve any two:

- a) Steel ball bearings ($k = 50 \text{ W/mK}$, $\alpha = 1.3 \times 10^{-5} \text{ m}^2/\text{s}$) having a diameter of 40 mm are heated to a temperature of 650°C and then quenched in a tank of oil at 55°C. If the heat transfer coefficient between ball bearings and oil is 300 W/m²K. Determine the duration of time the bearing must remain in an oil to reach a temperature of 200°C. [8]

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- b) A plate 2 cm thick and 2 cm wide is used to heat a fluid at 30°C. The heat generation rate inside the plate is $7 \times 10^6 \text{ W/m}^3$. Determine heat transfer coefficient to maintain the temperature of the plate below 180°C. Take k for plate 26 W/mK. Neglect heat losses from the edge of plate. [8]
- c) Derive the equation for temperature distribution & heat transfer through a plane wall with uniform heat generation; also convert this equation in terms of ambient temperature & the heat transfer coefficient. [8]

23) Solve any two:

- a) Explain the error estimation of temperature measurement in thermo-well. [8]
- b) Derive the expression for temperature distribution for a short fin with convective tip. [8]
- c) An aluminum alloy fin ($k = 200 \text{ W/mK}$), 3.5 mm thick and 2.5 cm long protrudes from the wall. The base is at 420°C and ambient air temperature is 30°C. The heat transfer coefficient may be taken as 11 W/m²K. Find the heat loss and fin efficiency, if the heat loss from the fin tip is negligible. [8]

24) Solve any two of the following:

- a) Give the physical significance of [8]
- Nusselt Number
 - Grashoff's Number
 - Reynolds Number
 - Prandtl Number
- b) Assuming a man as a cylinder of 40 cm diameter and 1.72 m height with surface temperature of 37°C. Calculate the heat loss from his body while standing in wind flowing at 20 km/hr at 17°C. Use following correlation; [8]
- $$Nu = 0.027 Re^{0.805} Pr^{1/3}$$
- The properties of fluid at mean film temperature are $\rho = 1.1614 \text{ kg/m}^3$, $\nu = 184.6 \times 10^{-7} \text{ Ns/m}^2$, $Pr = 0.707$, $k = 0.0263 \text{ W/mK}$.
- c) Estimate the heat transfer rate from 100 watt incandescent bulb at 140°C to an ambient air at 24°C. Approximate the bulb as 60 cm diameter sphere and calculate percentage loss by natural convection. Use following correlation; [8]
- $$Nu = 0.60 [Gr.Pr]^{1/4}$$
- The properties of air at 82°C are kinematic viscosity (ν) = $21.46 \times 10^{-6} \text{ m}^2/\text{s}$, $K = 30.38 \times 10^{-3} \text{ W/mK}$, $Pr = 0.699$.

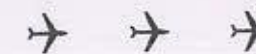
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25) Solve any two of the following:

- a) Write short Note on: [8]
- Radiation shape factor
 - State and prove Kirchhoff's Law
- b) Write Plank's law and derive Stefan Boltzmann law from Plank's law. [8]
- c) Calculate the following for an industrial furnace in the form of black body and emitting radiations at 2500°C. [8]
- Monochromatic emissive power at wavelength 1.2 μm
 - Wavelength at which emission is maximum
 - Maximum emissive power
 - Total emissive power

26) a) Write short notes on: [12]

- Define Fouling factor and explain causes of fouling
 - Types of Condensation and boiling
- b) Hot oil with capacity rate ($m \times C_p$) of 2500 W/K flows through a double pipe heat exchanger. It enters at 360°C and leaves at 300°C. Cold fluid enters at 30°C and leaves at 200°C. If overall heat transfer coefficient (U) is 800 W/m²K, determine the heat exchanger area required for parallel and counter flow. [6]



- b) The cutter of machine is pulled by square threaded screw of 55 mm external diameter and pitch of 10 mm. The operating nut takes the axial load of 400 N on a flat surface of 60 mm and 90 mm internal and external diameter respectively. If the coefficient of friction is 0.15 for all contact surfaces on nut. Determine power required to rotate operating nut when cutting speed is 6m/min. Also find efficiency of the screw. [12]

- 26) 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 to connect two transmission shafts rotating at 800 rpm and 400 rpm respectively. The centre to centre distance between the shafts is approximately 3m and the belt drive is open type. The power transmitted by the belt is 30 kW. The load correction factor is 1.3. 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 0.0147 kW. Select preferred pulley diameters and specify the belt. 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
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	190
	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						

EEE

Seat
No.

T.E. (Mechanical) (Part -III) (Semester - V) (Revised)

Examination, April - 2018

MACHINE DESIGN-I

Sub. Code: 66244

Day and Date : Friday, 27 - 04 - 2018

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 assumptions wherever required and state them clearly.
 - 4) Use of non-programmable calculator is permitted.
 - 5) Draw neat diagrams wherever necessary.

21) Solve any Three:

[18]

- a) Discuss the guidelines for the selection of quantitative values of 'factor of safety'.
- b) Suggest with justification the suitable material for the following:
 - i) Large Flywheel
 - ii) Helical spring
 - iii) Dairy Equipment
- c) Discuss the design of a bell-crank lever.
- d) Discuss different types of stresses in bolt design.

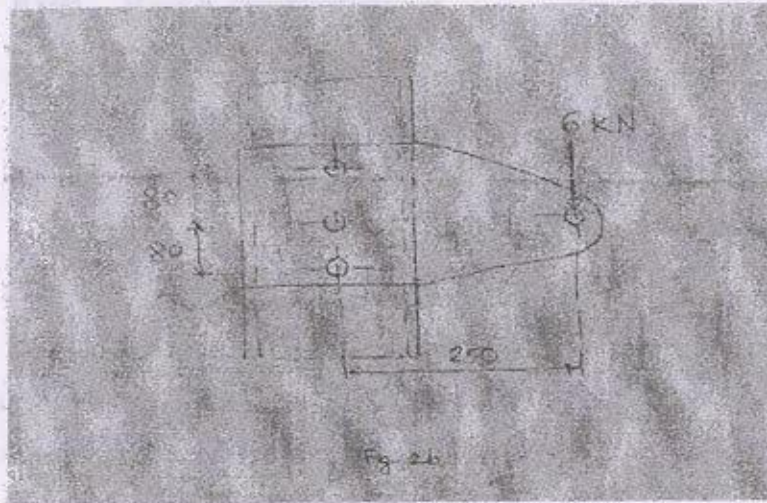
- 22) a) A knuckle joint used to connect two mild steel rods has to transmit a tensile load of 200 kN. Given: yield point strength of the material in tension 200 N/mm² and factor of safety = 2. Allowable stress in compression is two times the allowable stress in tension, and allowable stress in shear as 0.707 times that in tension. Design the knuckle joint. [8]



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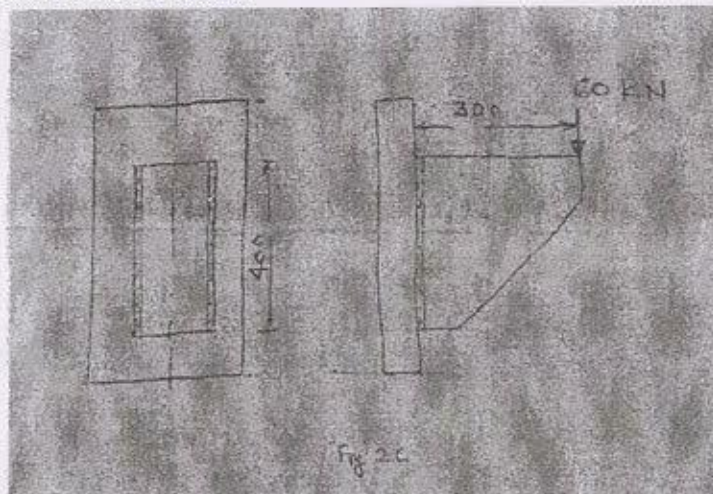
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- b) A steel plate is subjected to a force of 6 kN and fixed to the channel by means of three identical bolts as shown in figure 2b. The bolts are made of plain carbon steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$, factor of safety = 3). Determine the nominal diameter of bolts. [8]



OR

- c) Figure 2c shows a bracket is welded to the vertical plate by means of two fillet welds. Determine the size of welds if the permissible shear stress is limited to 72 N/mm^2 . [8]



- Q3) a) What are various types of keys? Compare stresses in woodruff key with flat key? [6]
- b) The propeller shaft is required to transmit 45 kW power at 500 rpm. It is a hollow shaft made of plain carbon steel and the permissible shear stress is 84 N/mm^2 . Calculate the inside and outside diameters of the shaft for [10]

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- i) Ratio of an inside diameter 0.6 times the outside diameter.
ii) Ratio of an inside diameter 0.65 times the outside diameter.
Determine the % saving in material by modifying the ratio.

OR

- b) Design a bushed-pin type flexible coupling for connecting a motor shaft to a compressor, with the following service conditions:
Power to be transmitted = 50 kW
Speed of motor shaft = 1000 r.p.m.
Diameter of motor and compressor shaft = 55 mm
Bearing pressure on the rubber bush = 0.7 N/mm^2
Allowable stress in the pins = 60 MPa
Allowable shear stress in the keys and shafts = 45 MPa
Allowable crushing stress in the keys = 60 MPa
Allowable shear stress in the flange material = 15 MPa

- Q4) a) Explain with neat sketches, the stresses induced in helical spring of circular cross section. [6]
- b) Design helical compression spring for a maximum load of 1000 N for deflection of 25 mm using the valve having spring index of 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm^2 . Assume squared and ground ends. [10]

Assume Wahl's Stress factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$

Where C - spring index

SWG	1	2	3	4	5
Diam. mm	7.620	7.010	6.401	5.893	5.385

- Q5) a) Discuss Various forms of threads used for power transmission giving their relative merits and limitations. [6]

OR

- a) Derive an expression for maximum efficiency for square threaded screw.