

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

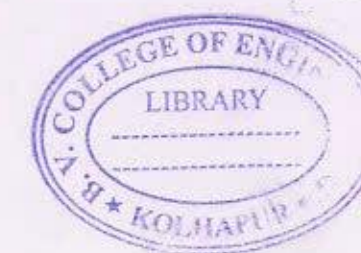
Q1) Solve any two of the following

[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.



Q2) Solve any two of the following

[16]

- Compare mechanical comparator with optical comparator with the help of neat sketches.
- Explain the use of sine bar for measuring an angle with the help of neat sketch and state its limitations.
- Explain construction, working and limitations of sigma comparator.

Q3) Solve any two of the following

[16]

- Define straightness and flatness. Briefly explain how straightness and flatness is measured and specified.
- Explain principle and working of Tomlinson's surface meter with neat sketch.
- Define surface texture, Lay and explain ten point average method for surface finish measurement.

Q4) Solve any two of the following

[16]

- Define major diameter, effective diameter and enumerate various errors in screw thread.
- Derive an expression for effective diameter measurement by 2-Wire method for external threads.
- Describe the gear tooth vernier caliper and explain its use for checking tooth thickness.

Q5) Solve any two of the following

[16]

- Differentiate between quality control and quality assurance.
- What is cost of quality? Explain cost of failure, cost of appraisal and cost of prevention.
- Discuss the factors that control, quality of design and quality of conformance.

Q6) Solve any two of the following

[18]

- State the advantages, applications of control charts and sketch different patterns of control charts
- Discuss following acceptance sampling terms
 - Average out going quality
 - Average out going quality level
 - Accepted quality level
- A machine is working to a specification $80.75 \pm 0.1\text{mm}$ a study of 32 consecutive pieces shows the following measurements. Construct the $\bar{X}$ and R chart and calculate process capability (For sample size of 8 take $A_2=0.37$, $D_4=1.86$, $D_3=0.14$, $d_2=2.847$)

1 st day	2 nd day	3 rd day	4 th 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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Total No. of Pages :3

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

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

Total Marks : 100

- 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:

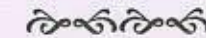
- a) Explain with neat sketch working of screw compressor used in pneumatic systems. [6]
- b) Explain schematically different piping layouts in Pneumatic systems. [6]
- c) Explain with the help of neat sketch the construction and working of air motor. [6]
- d) Explain the working of 5/2 Direction control 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

- Optimistic Criterion
 - Pessimistic Criterion
 - Leplace Criterion
 - 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.

	Jobs					
Machines	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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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 :
- 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 (5 Marks Each) [20]

- State the need of planning in manufacturing a component from vendors.
- Explain in brief Process of Organizing.
- Is there any difference between Authority & Responsibility. Justify your answer with suitable example.
- Discuss the implications of the Herzberg's theory as a strategy for motivating employees.
- 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]

- Which factors related to environmental influence sugar manufacturing industry?
- What are the problems of SSI involved in manufacturing components of automobile sector?
- 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]

- Types of markets
- 4 P's of market
- Functions of Purchase department
- Purchase policy and procedure
- Cost estimation



Q4) Attempt any three (6 Marks Each)

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

- b) Use graphical method to solve the following,

$$\text{Maximize } Z = 5X_1 + 4X_2$$

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)

$$\text{Minimise } Z = 5X_1 + 3X_2 + 2X_3$$

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

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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:

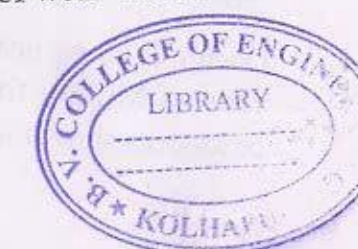
- a) Explain with neat sketch the types of milling cutters. [8]
- b) Derive an expression for Shear strain. [8]
- c) In an Orthogonal cutting of the material, Cutting force (F_H) = 138Kg, Feed force (F_V) = 68Kg, Rake angle (α) = 7°, Chip thickness ratio (r) = 0.4. Determine
 - i) Coefficient of friction of chip
 - ii) Shear force (F_s) and normal to shear force (F_n). [8]

Q2) Solve the following questions.

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

OR

- a) Explain concept of wear & types of wear with sketch. [8]
- b) Determine [8]



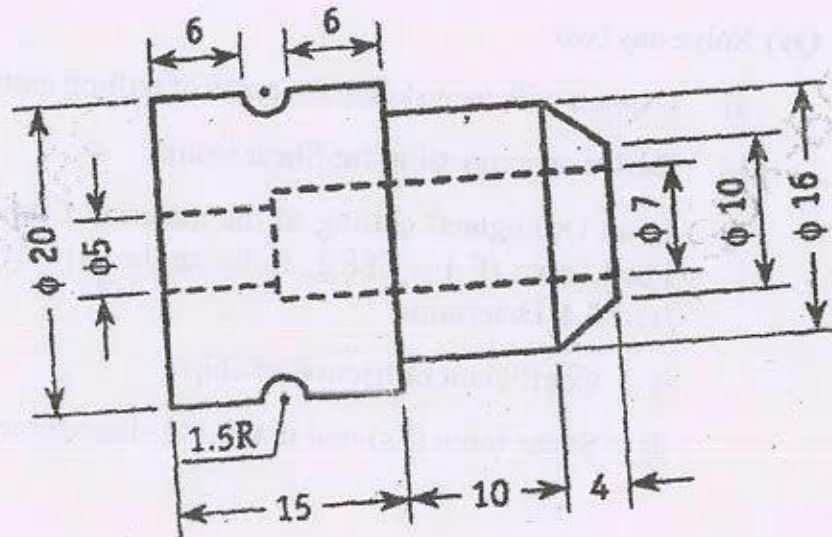
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- Taylor's Tool life equation
- Cutting speed for 6 minutes of tool life when tool life of 70 minutes is obtained at a speed of 25m/min and 15 minutes at 40m/min.

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

- Detailed process sheet
 - Tool Layout
 - Cam profile for drilling operation-of $\phi 5$ mm hole through
 - Calculate Production rate per hour
- Material - $\phi 20$ Bronze bar All dimensions are in mm.



SECTION - II

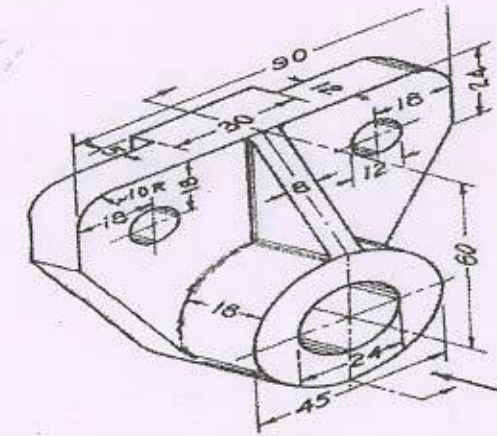
Q4) Design & draw neat dimensional drawing in three views with one sectional view of jig for drilling two holes $\phi 12$ in the given bracket as shown in figure. [26]

OR

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

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



- Attempt any two.
 - Explain with neat sketch the Compound die. [6]
 - Explain types of Stock stop. [6]
 - Explain the importance of following in Press working
 - Strippers
 - Clearanace

[12]

6) Write short notes any three.

- Construction & working of CNC.
- Automatic Tool Changer.
- CNC axes and drives.
- 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)

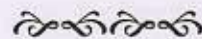
α_s (Deg)	130	140	150	160	170	180	190	200
F_d	1.26	1.19	1.13	1.08	1.04	1.00	0.97	0.94

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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Total No. of Pages :4

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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

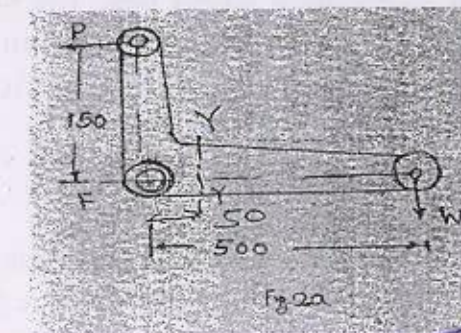
Time : 10.00 a.m. to 1.00 p.m.

- 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.

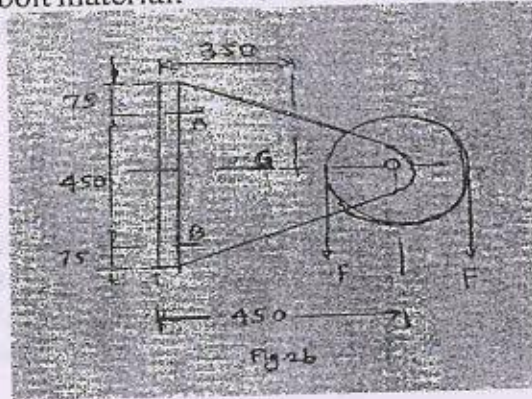
Q2) a) A bell crank lever to raise a vertical load is shown in fig 2a. The vertical load to be lifted is 4500N. The lever consists of forged steel material and a pin at the fulcrum F. Assume following data for the lever material. Safe stress in tension = 75 MPa; safe stress in shear = 60 MPa; safe bearing pressure on pins = 10 N/mm². Determine the pin diameter at end P, dimensions at F and cross section Y-Y (near to fulcrum) [8]



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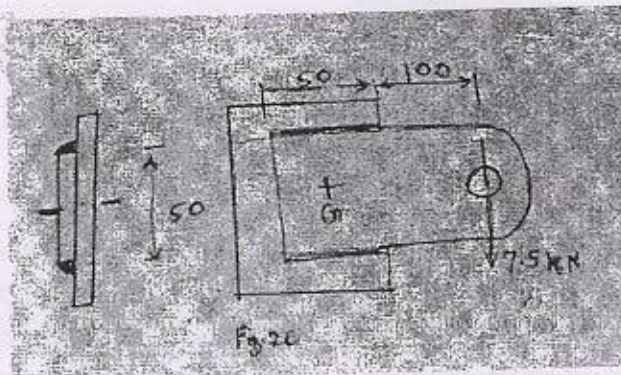
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- b) Figure 2b shows a pulley bracket, which is supported by 4 bolts, two at A and two at B. The weight of pulley and bracket, W is 1850N, and the load, F on the rope is 20kN. Determine the size of the bolts, using an allowable shear stress of 40 MPa for the bolt material. [8]



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/mm^2 . Assume static conditions. [8]



- 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

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- 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/mm^2 . 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 recalcitrating 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 mm^2	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.**

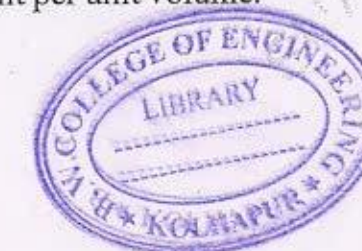
- Instructions :**
- 1) All Questions are compulsory.
 - 2) Figures to the right indicate full marks.
 - 3) Assume Suitable Data wherever necessary and state it Clearly.
 - 4) Use of scientific non programmable calculator is permitted.

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 ($k = 0.78 \text{ W/mK}$) separated by 10mm wide stagnant air space ($k = 0.0626 \text{ W/mK}$). 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 $40 \text{ W/m}^2\text{K}$. [6]
- d) An aluminum pipe carries steam at 110°C . The pipe ($k = 185 \text{ W/mK}$) 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 $15 \text{ W/m}^2\text{K}$. 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]

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- 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 ($\rho = 8954 \text{ kg/m}^3$, $C_p = 383 \text{ J/kgK}$, $k = 386 \text{ W/mK}$). 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 $200 \text{ W/m}^2\text{K}$. 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 of 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 ($k = 75 \text{ W/mK}$), 0.75mm thick, The fins protrude 2.5cm from the cylinder surface. The heat transfer coefficient is $23.3 \text{ W/m}^2\text{K}$. 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 $20 \text{ W/m}^2\text{K}$. 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, $\rho = 1.06 \text{ kg/m}^3$, $\gamma = 18.97 \times 10^{-6} \text{ m}^2/\text{s}$, $C_p = 1.004 \text{ kJ/kg}^\circ\text{C}$ and $k = 0.0285 \text{ W/m}^\circ\text{C}$, $\text{Pr} = 0.708$. [8]
- Use correlation; $\text{Nu}_L = 0.10 (\text{Gr.Pr})^{1/3}$.

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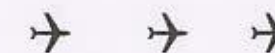
- c) Air at a temperature of 20°C flows through a rectangular duct with a velocity of 10m/s. The duct is $30\text{cm} \times 20\text{cm}$ in size and air leaves at 34°C . Find the heat gain by air when it is passed through 10m long duct. The properties of air at 27°C are $\rho = 1.1774 \text{ kg/m}^3$, $\gamma = 15.68 \times 10^{-6} \text{ m}^2/\text{s}$, $C_p = 1057 \text{ J/kgK}$ and $k = 0.03003 \text{ W/mK}$, $\text{Pr} = 0.708$. [8]
- Use correlation ; $\text{Nu} = 0.023 (\text{Re})^{0.8} \text{Pr}^{0.4}$.

25) Solve any two of the following:

- a) Write a short notes on; [8]
- Shape factor and its properties
 - 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 0.12m^2 is 527°C . [8]
- Calculate;
- The total rate of energy emission
 - The intensity of normal radiation
 - The wavelength of maximum monochromatic emissive power

26) a) Draw the temperature distribution curve for following heat exchangers (any 3) [6]

- Counter flow heat Exchanger
 - Evaporator
 - Parallel flow heat Exchanger
 - 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 $325 \text{ W/m}^2\text{K}$, calculate 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:

- Unbalanced primary and secondary forces, if any, and
- Unbalanced primary and secondary couples with reference to central plane of the engine. [12]

- 26) 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 $\pm 2\%$ 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/m^3 . [10]



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Total No. of Pages : 4

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

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

- Addendum.
- Module.

[8]

OR

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

- Pitch Circle.
- 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

- the least number of teeth that can be used on each wheel and
- 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]

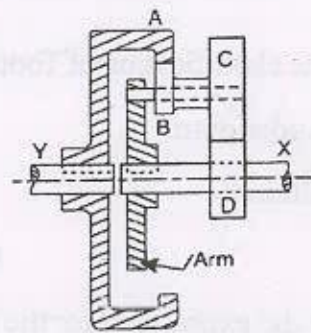


Fig. 2 b.

- 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]

- 24) 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 $G(S) H(S) = \frac{K}{S(S^2+6.S+12)}$. [12]

b) A unity feedback control system is having an open loop transfer function $G(S) = \frac{K(S+13)}{S(S+3)(S+7)}$. Determine the range of values of K for the system to be stable. [6]

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

$G(S) = \frac{1000}{S(1+0.1.S)(1+0.001.S)}$. 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]

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]

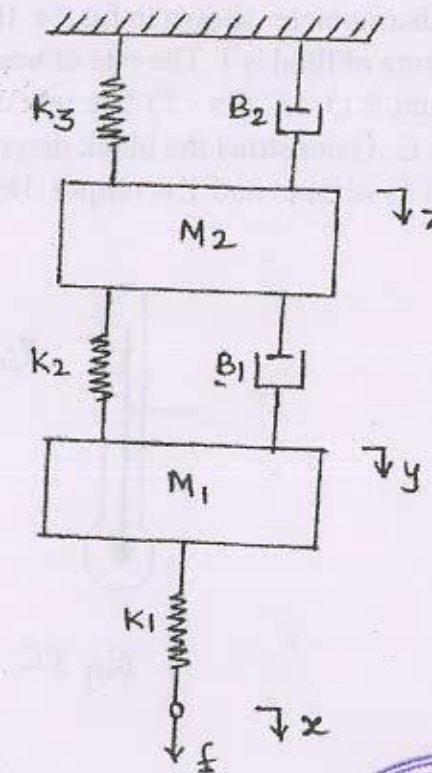


fig 1 a



- b) For the fluid system shown in Fig. 1b, determine equation of P_1 in terms of P_2 and P . [6]

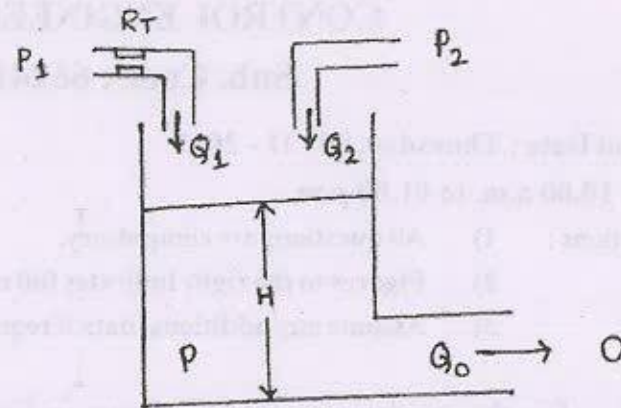


fig 1 b

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

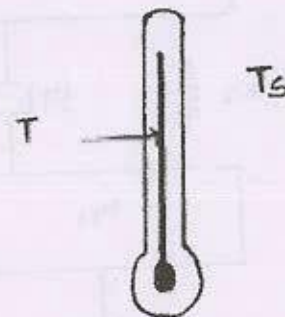


fig 1c

- 22) a) Determine linear approximation for the equation $Z = \sin X \cdot \cos Y$ for $X_i = 60^\circ$ and $Y_i = 30^\circ$. What is approximate value of Z when $X = 63^\circ$ and $Y = 28^\circ$. [8]

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

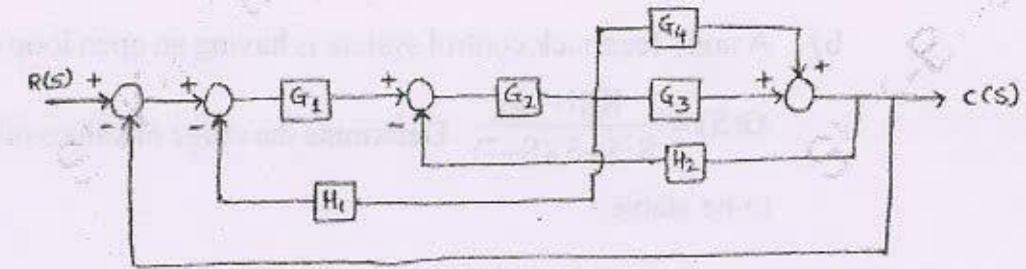


fig 2 b

- 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]

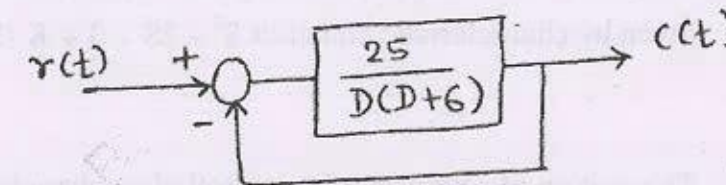


fig. 3 a

- 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]

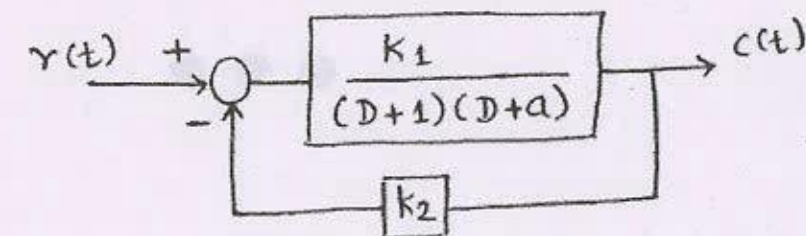


fig. 3 b

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Total No. of Pages : 4

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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) $\pm 350 \text{ N/mm}^2$ for 85% of time
 - ii) $\pm 400 \text{ N/mm}^2$ for 12% of time
 - iii) $\pm 500 \text{ N/mm}^2$ for 3% of time

The material for the component is 50C4 ($S_{ut} = 660 \text{ N/mm}^2$) and the corrected endurance limit of the component is 280 N/mm^2 . 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

OR

- 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]

Table no.1

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

OR

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- 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 = 3.2 kN

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

- Coefficient of friction
- Power lost in friction
- Minimum oil film thickness
- Flow requirement in litres/min
- Temperature rise

Refer following data table:

I/d	ϵ	h_0/C	S	ϕ	$(r/C)f$	$Q/(rCnD)$
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

SECTION - II

- Q4) a)** Explain different types of gear tooth failure.

[8]

OR

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

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- 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

($S_{ut} = 410 \text{ N/mm}^2$), while the gear is made of grey cast iron FG 200

($S_{ut} = 200 \text{ N/mm}^2$). 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]
- The transverse module
 - The transverse pressure angle
 - The axial pitch
 - The pitch circle diameters of the pinion and the gear
 - The centre distance and
 - 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]
- The centre distance
 - The speed reduction
 - The dimensions of the worm and
 - The dimensions of the worm wheel



Seat No.	
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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 advantages 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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Total No. of Pages : 3

Seat No.	
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S.E. (Mechanical) (Part - II) (Semester - IV) (Revised)
Examination, November - 2017
MACHINE TOOLS & PROCESSES
Sub. Code : 63364

Day and Date : Tuesday, 07 - 11 - 2017

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

Total Marks : 100

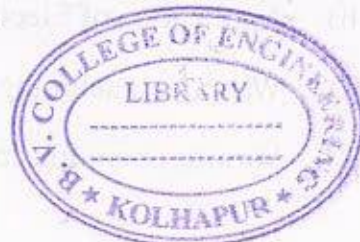
- Instructions :**
- 1) All Questions are compulsory.
 - 2) Figures to the right indicate full marks
 - 3) Assume suitable data, if necessary.
 - 4) Use of Non-programmable Scientific Calculator is allowed.

Q1) Attempt any four (4 marks each) :

- a) Explain the properties of molding sand . Suggest the methods to measure the same. [4]
- b) State the function of riser in the gating system. [4]
- c) What are the steps involved in gravity die casting. [4]
- d) Draw neat sketch of cupola furnace and name the parts. [4]
- e) List the defects related to molding process? Explain any two of them. [4]

Q2) Attempt any four (4 marks each) .

- a) Briefly explain principle of rolling with neat sketch. [4]
- b) Distinguish between open and closed die forging processes. [4]
- c) Show by schematic sketches the process of forward extrusion. Give two examples of components produced by extrusion. [4]
- d) Why is lubrication difficult in wire drawing process? State the methods generally employed in it. [4]
- e) Indicate by means of flow diagram the different stages in manufacture of 50 mm diameter rod from a steel ingot. [4]



P.T.O.

Q3) Write a short note on (Any Three) :

- a) Advantages and Limitations of sand casting process [6]
- b) Defects in forging [6]
- c) Injection molding [6]
- d) Thermoforming process for plastic [6]

Q4) Attempt any four (4 marks each)

- a) A lathe is provided with a change gear set from 20 to 125 teeth in steps of 5 teeth and an additional gear of 127 teeth. Find the gear train for cutting metric thread of 3 mm pitch on a lathe having lead screw pitch as 6 TPI. [4]
- b) How are a capstan and turret lathe headstock classified? Describe any one of them. [4]
- c) Describe in brief working principle of boring machine. [4]
- d) Draw neat sketch of following operations performed on drilling machine. [4]
 - i) Countersinking
 - ii) Counterboring
- e) Give the specification of lathe. [4]

Q5) Attempt any four (4 marks each) :

- a) Explain the method of carrying out an operation on shaper. [4]
- b) Outline the procedure of planning vertical surfaces. [4]
- c) Make a neat sketch of Universal milling machine. State its advantages. [4]
- d) What are various tool holding devices used on milling machine? [4]
- e) Compare the gear shaving with gear rolling. [4]

Q6) Write a short note on (Any Three) :

- a) Abrasive Jet Machining advantages & limitations [6]
- b) Application of Electro- Chemical machining with neat sketch [6]
- c) Water jet machining process [6]
- d) Various operations performed on milling machine [6]

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Total No. of Pages : 3

Seat
No.

S.E. (Mechanical) (Part - II) (Semester-IV) (Revised)

Examination, November - 2017

THEORY OF MACHINES - I

Sub. Code : 63363

Day and Date : Monday, 06-11-2017

Total Marks : 100

Time : 9.30 a.m. to 1.30 p.m.

- Instructions :
- 1) Attempt all questions.
 - 2) Figures to the right indicates full marks.
 - 3) Draw neat labeled sketch wherever necessary.
 - 4) Assume suitable data, if necessary and state clearly.
 - 5) Use of non-programmable calculator is allowed.

SECTION-I

Q1) a) Write a note on Grubler's criterion for planar mechanism. [8]

OR

- Explain the inversions of single-slider crank chain with neat sketches. [8]
- A reciprocating engine mechanism is shown in fig.1.b. Crank OC is 60 mm long and connecting rod CP is having length of 180mm. By using Klein's construction method, find the velocity and acceleration of the piston if the crank is rotating at 180 r.p.m. [8]

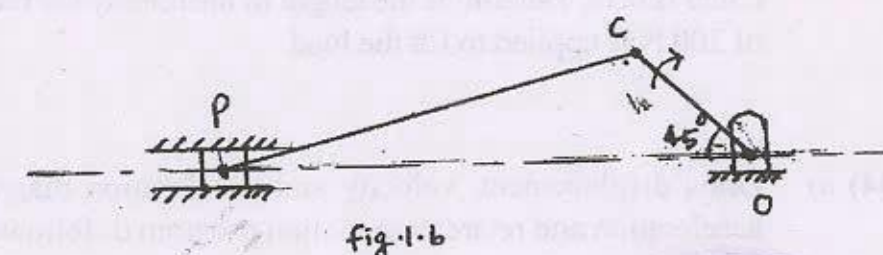


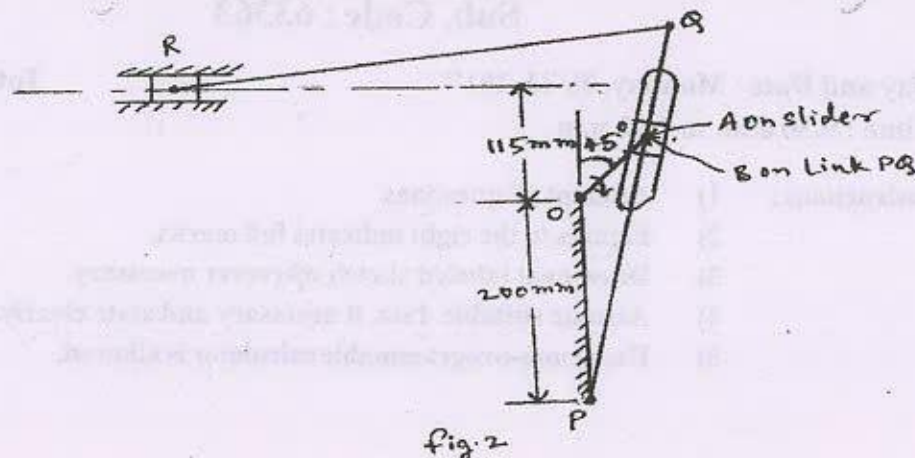
fig.1.b



P.T.O.

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- Q2) Crank OA of the quick return mechanism shown in fig. 2. revolves at a uniform speed of 250 r.p.m. in clockwise direction. The dimensions of various links are: OA = 75 mm, PQ = 375 mm, and QR = 400 mm. Crank makes 45° with vertical line PO. Find: i) velocity of R, ii) acceleration of R and iii) angular acceleration of QR. [18]



- Q3) a) Derive the equation for friction torque in case of conical pivot bearing assuming uniform pressure with usual notations. [8]

OR

- a) Derive the equation for friction torque in case of flat pivot bearing assuming uniform pressure condition. [8]
- b) A screw jack has square threaded screw with mean diameter of 40 mm. The pitch of the thread is 6 mm and the coefficient of friction at the screw is 0.16. The load to be lifted is 25 kN and is supported by a collar having mean diameter of 50 mm and the coefficient of friction at the collar is 0.18. Determine the length of the tommy bar required if an effort of 200 N is applied to lift the load. [8]

- Q4) a) Draw displacement, velocity and acceleration diagram for Uniform acceleration and retardation motion program of follower. [4]

SF-86

- b) A cam is operating an oscillating roller follower having SHM during outward and return stroke. Draw the cam profile for the following given data;

Distance of roller centre from cam centre at the start of ascent = 60 mm;

Follower arm length = 80 mm; Distance of pivot point from cam centre = 100 mm;

Angle of ascent = 60° ; Angle of descent = 90° ; Angle of dwell in between = 45°

Angle of oscillation of follower arm during ascent and descent = 15° [14]

- Q5) a) Derive the equation of ratios of belt tensions in case of flat belt drive. [6]

OR

- a) Explain slip and creep in belt. [6]
- b) An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shafts 3m apart and transmits 4 kW from smaller pulley that rotates at 300 rpm. Coefficient of friction between the belt and pulley is 0.3 and safe working tension is 10 N per mm width. Determine minimum width of belt, initial tension in belt. [10]

- Q6) a) Explain controlling force and controlling curve. [6]

OR

- a) Explain the terms height of governor, Isochronism and stability related to governor. [6]
- b) In a porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of rotation whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. What will be the equilibrium speeds for the two extreme radii of 250 mm and 300 mm of rotation of governor balls? [10]

- b) An axial flow compressor with compression ratio 6, draws air at 25°C, delivers it at 60°C. Assuming 50% degree of reaction, find the velocity of flow if the blade velocity is 100 m/sec and also find the number of stages. Take work factor = 0.85, $\alpha_1 = 10^\circ$ & $\beta_1 = 40^\circ$, $C_p = 1$ kJ/kgK. [8]
- Q6) a) Give the methods of improving the specific output and thermal efficiency of gas turbine and explain gas turbine with intercooling arrangement. [8]
- b) An open gas turbine plant works between the fixed absolute temperature limits 350 K, 1550 K, the absolute pressure limits being 1 bar and 14 bar. The isentropic efficiency of compressor is 0.85 and that of turbine 0.86. Estimate the net work done by the turbine. The calorific value of the fuel is 4200 kJ/kg.
- Assume
Efficiency of combustion chamber is 0.99,
Mechanical efficiency of whole assembly is 0.98,
Efficiency of generator is 0.985
Fuel air ratio = 1 : 54.06 and $m_a = 500$ kg/s. Take $C_p = 1.005$ kJ/kgK for air and gas. [8]

OR

- b) Operating conditions of the Gas turbine unit are given below
- The isentropic efficiency of compressor = 0.85
 - The isentropic efficiency of turbine = 0.82
 - A turbine unit has a pressure ratio 7:1
 - Maximum cycle temperature is 620°C
 - The air enters the compressor at 15°C at the rate of 20 kg/s
- Then calculate the workdone by turbine, compressor work and total work.
- Take $C_p = 1.005$ kJ/kgK and $\gamma = 1.4$ for the compression and $C_p = 1.11$ kJ/kgK and $\gamma = 1.35$ for the expansion. [8]



Seat No.	
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S.E. (Mechanical) (Part - II) (Semester - IV) (Revised)

Examination, November - 2017

FLUID AND TURBO MACHINERY

Sub. Code: 63362

Day and Date : Friday, 03 - 11 - 2017

Total Marks : 100

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

- Instructions :
- All questions are compulsory.
 - Figures to the right indicate full marks.
 - Assume suitable data if necessary.
 - Use of non-programmable calculator is allowed.

- Q1) a) Explain the different efficiencies of the turbine. [8]
- b) The following data were obtained from a test on a Pelton wheel [8]
- Head at the base of nozzle = 32m
 - Discharge through nozzle = 0.18 m³/s
 - Area of the jet = 7500 mm²
 - Power available at the shaft = 44 kW
 - Mechanical efficiency = 94%
- Calculate the power lost
- In the nozzle
 - In the runner
 - In mechanical friction
- OR
- c) A turbine work under a head of 200 m and it develops 6000 kW at 200 rpm. The overall efficiencies 87%. Find its unit quantities. A model is to built which is similar to above turbine in all respect having the scale 1:10, it is tested under a head of 20m. find the speed, discharge and specific speed of model having the same overall efficiency as turbine. [8]

P.T.O.



- b) An axial flow compressor with compression ratio 6, draws air at 25°C, delivers it at 60°C. Assuming 50% degree of reaction, find the velocity of flow if the blade velocity is 100 m/sec and also find the number of stages. Take work factor = 0.85, $\alpha_1 = 10^\circ$ & $\beta_1 = 40^\circ$, $C_p = 1$ kJ/kgK. [8]

- 26) a) Give the methods of improving the specific output and thermal efficiency of gas turbine and explain gas turbine with intercooling arrangement. [8]

- b) An open gas turbine plant works between the fixed absolute temperature limits 350 K, 1550 K, the absolute pressure limits being 1 bar and 14 bar. The isentropic efficiency of compressor is 0.85 and that of turbine 0.86. Estimate the net work done by the turbine. The calorific value of the fuel is 4200 kJ/kg.

Assume

Efficiency of combustion chamber is 0.99,

Mechanical efficiency of whole assembly is 0.98,

Efficiency of generator is 0.985

Fuel air ratio = 1 : 54.06 and $m_a = 500$ kg/s. Take $C_p = 1.005$ kJ/kgK for air and gas. [8]

OR

- b) Operating conditions of the Gas turbine unit are given below

- The isentropic efficiency of compressor = 0.85
- The isentropic efficiency of turbine = 0.82
- A turbine unit has a pressure ratio 7:1
- Maximum cycle temperature is 620°C
- The air enters the compressor at 15°C at the rate of 20 kg/s

Then calculate the workdone by turbine, compressor work and total work.

Take $C_p = 1.005$ kJ/kgK and $\gamma = 1.4$ for the compression and $C_p = 1.11$ kJ/kgK and $\gamma = 1.35$ for the expansion. [8]



Seat No.	
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S.E. (Mechanical) (Part - II) (Semester - IV) (Revised)

Examination, November - 2017

FLUID AND TURBO MACHINERY

Sub. Code: 63362

Day and Date : Friday, 03 - 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 if necessary.
 - 4) Use of non-programmable calculator is allowed.

- Q1) a) Explain the different efficiencies of the turbine. [8]

- b) The following data were obtained from a test on a Pelton wheel [8]

- Head at the base of nozzle = 32m
- Discharge through nozzle = 0.18 m³/s
- Area of the jet = 7500 mm²
- Power available at the shaft = 44 kW
- Mechanical efficiency = 94%

Calculate the power lost

- 1) In the nozzle
- 2) In the runner
- 3) In mechanical friction

OR

- c) A turbine work under a head of 200 m and it develops 6000 kW at 200 rpm. The overall efficiencies 87%. Find its unit quantities. A model is to built which is similar to above turbine in all respect having the scale 1:10, it is tested under a head of 20m. find the speed, discharge and specific speed of model having the same overall efficiency as turbine. [8]

P.T.O.



SF - 85

- 12) a) What is governing of turbine? Explain governing of Francis turbine with neat sketch. [8]
- b) An inward flow reaction turbine has outer diameter of 1m and inner diameter 0.5m. The vanes are radial at the inlet and discharge is radial at the outlet. Water enters vane at an angle of 10° . Assuming velocity of flow to be constant at 3m/sec. Find speed of the wheel and vane angle at outlet. [8]

OR

- c) A Kaplan turbine works under head of 16m. Runner diameter is 2.5 times diameter of hub; speed of turbine is 105 rpm. Angle of vane tip at outlet extreme edge is 20° and $K_f = 0.6$. [8]

Assume radial discharge.

Calculate i) Runner diameter

ii) Hub diameter

iii) Discharge through turbine

- 13) a) Define specific speed of pump and obtain expression of it. What is significance of it? [8]
- b) Write short notes (any two) [10]
- Priming and its necessity
 - NPSH
 - Derive expression for minimum starting speed of centrifugal pump.

OR

- c) i) A centrifugal pump is running at 1000 rpm. The outlet vane angle of impeller is 45° and velocity of flow at out 2.5 m/sec. Discharge through pumps is 200 lit/sec working against total head of 20m. If manometric efficiency is 80%, find impeller diameter and width of impeller at outlet. [5]
- ii) Centrifugal pump of impeller diameter 0.30m discharging $0.03 \text{ m}^3/\text{s}$ water against a total head of 15 m and the pump is running at 1000 rpm. Find the discharge, head and ratio of power of a geometrically similar pump of diameter 0.15 m when it is running at 2500 rpm. [5]

SF - 85

- 14) a) Prove that the expression for volumetric efficiency in reciprocating compressor with effect of clearance volume is

$$n_v = 1 - \frac{V_c}{V_s} \left[\left(\frac{P_2}{P_1} \right)^{\frac{1}{\gamma}} - 1 \right]$$

Where,

V_c is Clearance volume, V_s is swept volume and P_2/P_1 is the pressure ratio. Also discuss the effect of Clearance ratio on the volumetric efficiency of the compressor. [8]

- b) Write short notes on any two: [10]
- Requirement of multistage of reciprocating compressors.
 - Workdone by reciprocating compressor during adiabatic and isothermal compressions.
 - Classification of reciprocating compressors.

OR

- b) i) A single acting single stage compressor is belt driven from an electric motor at 400 rpm. The cylinder diameter is 15cm and the stroke 17.5 cm. The air is compressed from 1 bar to 7 bar and the law of compression $PV^{1.3} = \text{Constant}$. Find the power of the motor, if transmission efficiency is 97% and the mechanical efficiency of compressor is 90%. Neglect clearance effect. [5]
- ii) The pressure in the mains of compressor air service is to be 8 bar and a supply of $28 \text{ m}^3/\text{hr}$ at 15°C and that pressure is to be maintained. The air is compressed from an initial pressure 1 bar by a two stage compressor in which the compression is adiabatic. The air is cooled to its initial temperature of 15°C in the inter cooler. What is the minimum power required to compress the air? Take $R = 287 \text{ J/kgK}$. [5]

- Q5) a) Explain the concept of Slip factor and Power input factor. [8]
- b) A Centrifugal compressor delivers 40 kg of air per minute at a pressure of 3 bar and 120°C . The intake pressure and temperature of the air is 1 bar and 25°C . If no heat loss to the surrounding, find
- Index of compression
 - Power required, if the compression is isothermal
- (Take $R = 287 \text{ J/kgK}$ and $C_p = 1.005 \text{ J/kgK}$) [8]

OR

- b) A cantilever of length 2 m carries a UDL of 2 kN/m over a length of 1 m from the free end and a point load of 1 kN at the free end. Find the slope and deflection at the free end if $E=2.1 \times 10^5 \text{ N/mm}^2$ and $I=6.667 \times 10^7 \text{ mm}^4$ [8]

OR

- b) State the importance of theories of failure and explain the maximum Principal stress theory. [8]
- Q6) a) State the assumptions made in Euler's column theory and derive its expression for the crippling load when both the ends of the column are hinged. [8]
- b) The maximum stress produced by pull in bar of length 1 m is 150 N/mm^2 . The area of cross sections and lengths are as shown in fig.5. Calculate the strain energy stored in a bar if $E=2 \times 10^5 \text{ N/mm}^2$ [8]

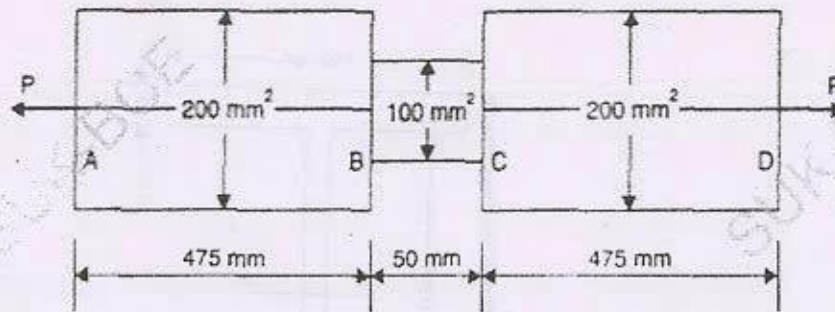


Fig. 5

& & &

Seat
No.

S.E. (Mechanical) (Semester - IV) Examination, November - 2017
ANALYSIS OF MECHANICAL ELEMENTS
Sub. Code: 63361

Day and Date : Thursday, 02 - 11 - 2017

Total Marks : 100

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

- Instructions :**
- 1) All questions are compulsory.
 - 2) Assume suitable data wherever necessary and state it clearly.
 - 3) Figures to the right indicate full marks.
 - 4) Draw neat and labeled sketches wherever necessary.
 - 5) Use of non programmable calculator is allowed.

- Q1) a) Three pillars two of aluminum and one of steel support a rigid platform of 200 kN as shown in the fig.1. If area of each aluminum pillar is 1000 mm^2 and that of steel pillar is 800 mm^2 , find the stresses developed in each pillar.

Take $E_s = 1 \times 10^5 \text{ N/mm}^2$ and $E_a = 2 \times 10^5 \text{ N/mm}^2$. What additional load P, can it take, if working stresses are 65 N/mm^2 in aluminum and 150 N/mm^2 in steel? [12]

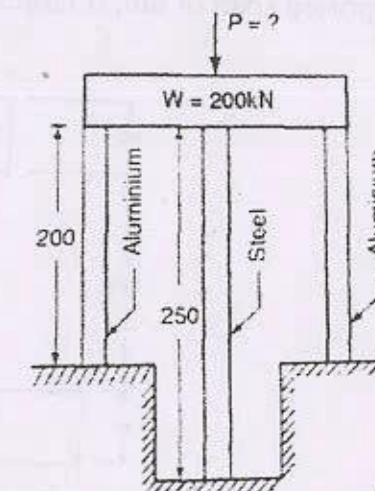


Fig.1



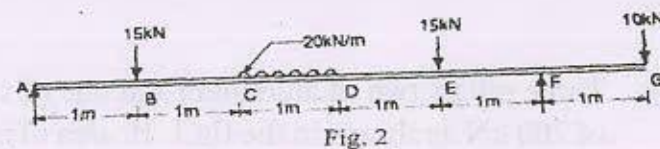
SF - 84

- b) Explain thermal stresses and hence derive the expression for thermal stress induced in a bar with its ends fixed by rigid support. [6]

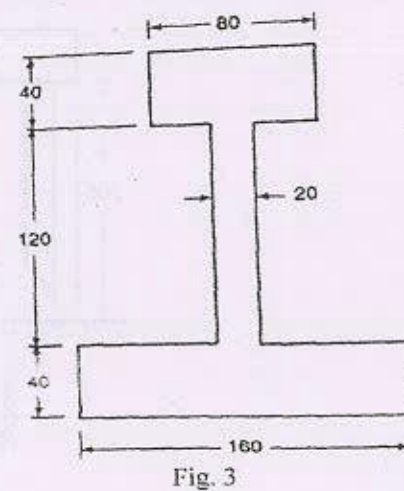
OR

- b) A hollow circular shaft 200 mm external diameter and thickness 25mm is transmitting power at 200 rpm. The angle of twist over the length of 2m was found to be 0.5° . Calculate the power transmitted and the maximum shear stress induced in the shaft. Take modulus of rigidity as 84 kN/mm^2 [6]

- 2) Draw SFD and BMD for loading condition shown in fig 2. Locate point of contraflexure and maximum bending moment if any. [16]



- 3) A cast iron beam has I section with top flange $80 \text{ mm} \times 40 \text{ mm}$, web $120 \text{ mm} \times 20 \text{ mm}$ and bottom flange $160 \text{ mm} \times 40 \text{ mm}$. as shown in Fig 3 if tensile stress is not to exceed 30 N/mm^2 and compressive stress 90 N/mm^2 , what is the maximum UDL the beam can carry over a simply supported span of 6m, if larger flange is in tension. [6]



-2-

SF - 84

- 4)a) Derive the expression for the principal stresses and the maximum shear stress for a member subjected to simple shear stress. Show the locations of Principal Planes and Planes of Maximum shear stress. [9]

- b) At a point in a strained material the principal stresses are 140 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine the normal stress, shear stress and the resultant stress on a plane inclined at 45° to axis of major Principal stress. What is the intensity of maximum shear stress at the point? [9]

OR

- b) An I-section beam $350 \text{ mm} \times 150 \text{ mm}$ has a web thickness of 10mm and a flange thickness of 20mm. (Fig.4) If the shear force acting on the section is 40 kN, find the maximum shear stress developed in the I-section. Also sketch the shear stress distribution across the section. [9]

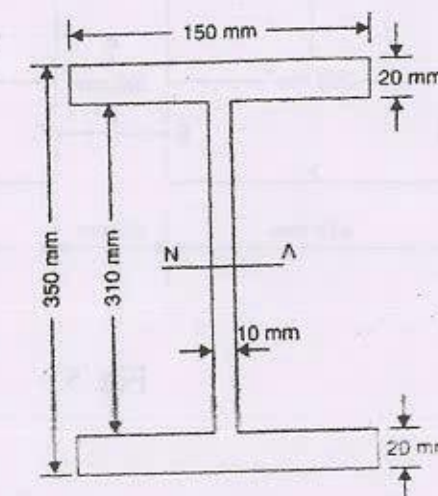


Fig.4

- Q5) a) Derive the expression for slope and deflection of a simply supported beam subjected to an UDL for the whole span, using double integration method. [8]

-3-

Total No. of Pages : 3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Examination, November - 2017

Sub. Code : 63354

Total Marks : 100

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

Instructions :

- 1) All questions are compulsory.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of non programmable calculator is allowed.
- 5) Assume suitable data if necessary.

Q1) a) Define viscosity, surface tension and capillarity and write their units in S.I. system. [6]

b) A thin square plate $1\text{ m} \times 1\text{ m}$ is placed horizontally at the centre in a horizontal gap of height 2 cm filled with oil of viscosity 10 poise . The plate is pulled at a constant velocity of 0.1 m/s . Find the force on the plate.

If the gap is now filled with another oil. When the plate is placed at a distance of 0.5 cm from one of the surfaces of the gap and pulled with the same velocity, if the force on the plate remains same as before, find the viscosity of the new oil. [6]

c) Define Buoyancy and meta centre. [4]

Q2) a) Distinguish by giving examples, Laminar and Turbulent flow, Steady and Unsteady flow, Uniform and Non uniform flow and Compressible and Incompressible flow. **[8]**

b) Solve any one of the following : [8]

i) Find the value of a such that the flow field given by $V = (axy - z^3)i + (a - 2)x^2j + (1 - a)xz^2k$ is irrotational.



P.T.O.

SF-81

- ii) An air plane flies at an altitude where the pressure and density of air are 40 KN/m^2 and 0.58 Kg/m^3 respectively. If the stagnation pressure measured by a pitot tube is 57 KN/m^2 , compute the speed of the aeroplane and the stagnation temperature and stagnation density. Take $R = 287 \text{ J/KgK}$ and ratio of specific heats is 1.4.
- 3) a) i) Bernoulli's theorem is based on which principle? Give its statement. Name three devices where Bernoulli's equation is applied. [4]
- ii) Derive an expression for discharge over a triangular notch in terms of head of liquid over the crest of the notch and the included angle. [5]
- b) Solve any one of the following :
- i) A venturimeter is used for the measurement of discharge of water in a horizontal pipeline. The pipe diameter is 20 cm and the throat diameter is 12 cm. When the flow of 130 lit/sec is flowing, the attached manometer shows a head difference of 50 cm if the coefficient of discharge of the venturimeter is 0.98 find the density of manometric fluid in the manometer.
- ii) A circular tank of diameter 3 mt contains water up to a height of 4 mt. If the water is discharged through a 10 cm diameter orifice at the bottom of the tank, find the height of water above the orifice after 5 minutes. Assume coefficient of discharge of orifice is 0.63.
- 24) a) i) Discuss the applications of momentum equation. [4]
- ii) Explain with a neat sketch how pitot tube is used to measure discharge through pipe. [4]
- b) An oil of viscosity 9 poise and specific gravity 0.9 is flowing through a horizontal pipe of 60 mm diameter. If the pressure drop in 100 mt. length of the pipe is 1800 KN/m^2 determine [8]
- i) Wall shear stress and frictional drag for 100 mt. length.
- ii) Power required to maintain the flow.
- iii) The velocity gradient at the pipe wall.
- iv) The velocity and shear stress at 8 mm from the wall.

SF-81

- i) a) i) Explain the concept of equivalent pipe. [5]
- ii) Discuss the causes of minor energy losses in flow through pipes. [4]
- b) Solve any one of the following : [9]
- i) Three pipes of diameters 30 cm, 20 cm and 40 cm and lengths 450 mt, 255 mt and 315 mt respectively are connected in series. The difference in water surface levels in two tanks is 18 mt. Determine the rate of flow of water if coefficients of friction are 0.0075, 0.0078 and 0.0072 respectively considering
- A) Minor losses also B) Neglecting minor losses.
- ii) A horizontal pipe line 15 cm in diameter is joined by sudden enlargement to 25 cm diameter pipe. Measurements indicate that when flow is from smaller to larger cross section the head loss is 0.5 mt in excess of that when the flow takes place from larger to smaller section. Determine flow rate. Take coefficient of contraction $C_c = 0.63$.
- 26) a) What do you mean by boundary layer separation? Why does it occur? With neat sketches explain the methods used to control the separation of boundary layer. [8]
- b) Solve any one of the following : [8]
- i) A geometrically similar model of an air duct is built to 1 : 25 scale and tested with water which is 50 times more viscous and 800 times denser than air. When tested under dynamically similar conditions the pressure drop is 2 bar in the model. Find the corresponding pressure drop in the full scale prototype.
- ii) Define pressure drag and skin drag or shear drag. A 2.5 mt long body having a projected area of 2.4 m^2 normal to the direction of motion is having a viscosity of 0.0012 Ns/m^2 . Find the drag on the body if it has drag coefficient of 0.45 for Reynolds number of 7×10^6 .

SF-80

Total No. of Pages : 3

Seat
No.

S.E. (Mech) (Part - II) (Semester-III) (Revised)

Examination, November - 2017

METALLURGY

Sub. Code : 63353

Day and Date : Tuesday, 21 - 11 - 2017

Total Marks : 100

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

- Instructions :
- 1) Solve any three questions from each section.
 - 2) Answers for both sections to be written in the same answer book.
 - 3) Figures to the right indicate full marks.
 - 4) Draw neat figures wherever necessary.

SECTION-I

Q1) Answer any three of the following. Each question carries equal marks. [18]

- a) With neat sketches. Explain the process of Solidification by nucleation, crystallization and growth.
- b) Explain the phenomenon of coring using equilibrium diagram? How can be cored structures avoided or eliminated?
- c) Draw a typical equilibrium diagram for impure/ partial eutectic systems and explain the cooling and solidification of any hypoeutectic alloy from above melting temperature to room temperature and draw the room temperature structure.
- d) Draw the crystal structures of BCC and FCC and evaluate the number of atoms per unit cell for both.

Q2) a) Draw Fe-Fe₃C equilibrium diagram. Indicate all the phases. Temperatures and Compositions. [8]

- b) What is SG Iron? Explain the process of manufacturing SG Iron. Draw the microstructure of SG iron and Gray Cast iron and compare their properties. [8]

P.T.O.



SF-80

- Q3) a) Draw typical equilibrium diagram of Al-Cu alloy system? Explain the process of precipitation hardening treatment and its effects. Write the applications. [7]
- b) Draw self explanatory sketches of any three. [9]
- i) Substitutional and interstitial type solid solution.
 - ii) Microstructure of white and malleable cast irons.
 - iii) Microstructure of 0.4 and 1.2% carbon steel.
 - iv) Microstructure of 70:30 brass as cast and annealed
 - v) X-ray Radiography.
 - vi) SN curve and Creep curve.

Q4) Write short notes on any four.

- a) Solid solutions.
- b) Tool steels.
- c) Ferritic Stainless steels.
- d) Dye Penetrant Testing.
- e) Impact Testing.

[16]

SECTION-II

- 5) a) Draw flowchart for carbide cutting tools manufactured by powder metallurgy techniques, why pre-sintering is necessary in such tools? [9]
- b) Classify different types of heat treatment furnaces? Explain rotary hearth furnace with neat sketch? [9]
- 6) a) Explain precipitation in Al-Cu alloys with respect to composition, aging time and temperature, over-aging? [8]
- b) Classify case carburizing methods? Explain pack carburizing with neat sketch. [8]

SF-80

Q7) Differentiate clearly between any four of the following. [16]

- a) Hardening and Tempering.
- b) Flame and Induction hardening.
- c) TTT and CCT curves.
- d) Pearlite and ferrite.
- e) Annealing and normalizing.

Q8) Write short notes on any four of the following. [16]

- a) Liquid phase sintering.
- b) Induction hardening.
- c) heat treatment defects.
- d) Bainitic transformation.
- e) Self lubricating bearing.

☆ ☆ ☆

SF - 79
[8]

16) a) Define the following as related to steam turbine.

- i) Speed ratio
- ii) Blade velocity coefficient
- iii) Diagram efficiency
- iv) Stage efficiency

OR

Explain the pressure compounding of impulse turbine showing pressure and velocity variations along the axis of the turbine.

b) The following particulars refer to a stage of a Parson's turbine comprising one ring of fixed blades and one ring of moving blades.

Mean diam. of blade ring = 70 cm

Speed of turbine = 3000 rpm

Steam velocity at exit from blade = 160 m/s

Blade outlet angle = 20°

Steam flow rate = 7 kg/s

Draw velocity diagram & find

- i) Blade inlet angle
- ii) Tangential force
- iii) Power developed

EEE

SF -79

Total No. of Pages : 4

Seat
No.

S.E. (Mech.) (Part - II) (Semester - III)
Examination, November - 2017
APPLIED THERMODYNAMICS
Sub. Code: 63352

Day and Date : Wednesday, 15 - 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 if necessary.
 - 4) Draw neat sketch wherever necessary.
 - 5) Use of steam table, mollier chart and non-programmable calculator is allowed.

Q1) a) State and prove Carnot Principle. [8]

OR

- b) Prove that Entropy of an isolated system during a process always increases. [8]
- c) An insulated cylinder of volume capacity 4 m^3 contains 20 kg of nitrogen. Paddle work is done on the gas by stirring it till the pressure in the vessel gets increased from 4 bar to 8 bar. Determine change in entropy. Take for nitrogen $C_p = 1.04 \text{ kJ/kgK}$ and $C_v = 0.7432 \text{ kJ/kgK}$. [8]

Q2) a) Write a note on steam tables and Mollier chart. [8]

OR

- b) Write a note on Reheat and Regenerative steam power cycles. [8]



P.T.O.

SF - 79

- c) A steam turbine receives steam at a pressure of 20 bar and superheated to 87.6°C. The exhaust pressure is 0.07 bar and the expansion of steam takes place isentropically. Calculate following using steam table [10]

- i) Heat supplied
- ii) Heat rejected
- iii) Net work done
- iv) Thermal efficiency
- v) SSC.

- 13) a) Classify boilers. Compare water tube boilers with fire tube boilers. [8]

OR

- b) What is function of air pump in condenser? Explain with neat sketch working of Edward's air pump. [8]
- c) A prime mover uses 15,000 kg of steam per hour develops 2450 kW. The steam is supplied at 30 bar and 350°C. The exhaust from the prime mover is condensed at 725 mm of Hg when barometer reads 755 mm of Hg. The condensate temperature from the condenser is 31°C and the rise in circulating water temperature is 10°C. Determine: [8]

- i) The quality of steam entering the condenser.
- ii) The quantity of circulating water required.
- iii) Cooling ratio.

Assume that no air is present in the condenser.

SF - 79

- 14) a) What is the function of the nozzle? Describe different types of steam nozzles with suitable sketch. [8]

OR

- b) Explain the terms, degree of under cooling and degree of super saturation. What are the effects of supersaturation? [8]

- c) Steam at a pressure of 15 bar and dryness fraction 0.97 is discharged through a convergent- divergent nozzle to a back pressure of 0.2 bar. The mass flow rate is 9 kg/kwh. If the power developed is 220 kW. Determine [8]

- i) Throat pressure.
- ii) Number of nozzles required if each nozzle has a throat of rectangular cross section of 4 mm × 8 mm.

- 15) a) Classify the turbines and compare impulse turbine with reaction turbine. [8]

- b) A impulse turbine has exit steam velocity from a nozzle equal to 900 m/s. The nozzle makes an angle of 20° to the tangent of the rotating wheel. The main blade speed is 300 m/s. The blades are equiangular. The mass of steam flowing through the turbine is 1200 kg/hr. Calculate [9]

- i) The blade angles.
- ii) The blade efficiency.
- iii) The power developed.

Take blade velocity co-efficient = 0.85.

Seat
No.

S.E. (Mechanical) (Semester - III)
Examination, November - 2017
ELECTRICAL TECHNOLOGY
Sub. Code : 63351

Day and Date : Monday, 13-11-2017

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 marks.
 - 3) Draw neat figures wherever necessary
 - 4) Assume suitable data, if missing. State it clearly.

SECTION - I

Q1) a) Derive the expression for speed and torque of dc motor. [1 × 8]

OR

Draw circuit diagrams and torque speed characteristics of dc shunt motor, dc series motor and dc cumulative compound motor.

Answer any two of the following (b, c, d). [2 × 6]

- b) Draw the diagram and explain the working of 4 point starter.
- c) Explain the basic methods of electric braking of dc motor.
- d) A DC series motor runs at 1200 rpm driving a constant torque load by taking 10 A current from 200V supply. Now 5 ohm resistance is connected in series with the motor. Find the new armature current and new speed. The armature resistance is 0.6 ohm. Field resistance is 0.5 ohm.

Q2) Answer any TWO [2 × 8]

- a) State three advantages of using 3 phase induction motor rather than dc motor. Describe the construction of cage type rotor.



P.T.O.

SF-78

- b) Torque of 3 phase induction motor is given by $\frac{120 s E_2^2 R_2}{2\pi N_s (R_2^2 + s^2 X_2^2)}$
 where E_2, R_2, X_2, s, N_s are rotor induced emf per phase at standstill, Rotor resistance per phase, Rotor reactance per phase at standstill, slip and synchronous speed respectively. Write the value of slip and expression for torque at
- Starting
 - When the torque is maximum
 - If rotor speed=Synchronous speed.
- c) A 4 pole, 230V, 50Hz, 3 phase induction motor draws 10A at 0.8 pf while running at 1450rpm. The stator loss is 100W, frictional loss is 100W. Find the rotor Cu loss. Neglect the rotor iron loss and find efficiency of the motor.

Q3) Answer any TWO

[2 × 8]

- Why DOL starter should be used for small rating motors? Describe DOL starter for 3 phase induction motor.
- Describe rotor side speed control methods of 3 phase induction motor.
- Explain the 'constant v/f' speed control method. Why it is the most popular method these days?

SECTION - II

Q4) Answer any TWO

[2 × 8]

- What are the desirable properties of servo motor? Describe methods of controlling dc servo motor.
- Describe a linear induction motor. State its applications.
- State advantages of brushless dc motor over conventional de motor. How is commutation obtained in BLDC motor?

SF-78

[2 × 8]

Q5) Answer any TWO

- Explain the factors to be considered for selecting a motor for a particular drive.
- Explain with examples the terms- active load, passive load, multimotor drive.
- Classify mechanical loads based on how the torque requirement changes with driving speed. Explain.

Q6) Answer any TWO

[2 × 8]

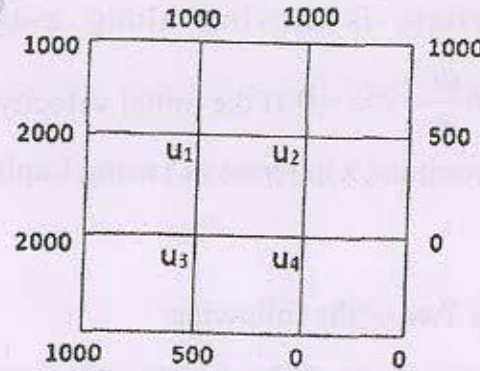
- Compare direct arc type furnace with indirect arc furnace in all aspects.
- Describe the set up and operation for eddy current heat treatment of metallic parts.
- A 200 kW resistance oven is to be operated in such a way that its maximum temperature is not to exceed 1700°C. The initial temperature of the charge is 420°C. If heating element is a wire of diameter 0.6 cm is used, find the length required. Also find resistance of heating element.

Radiating efficiency=0.5, Emissivity=0.5, Specific resistance of heating element= 150×10^{-6} ohm-cm.



iv) $u(x, \infty)$ is finite

- b) Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in figure by Gauss-Siedal iterative method by per. [16]



Seat No.

S.E. (Mechanical Engg.) (Semester - III) (Revised)

Examination, November - 2017

ENGINEERING MATHEMATICS - III

Sub. Code : 63350

Day and Date : Friday, 10 - 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) Use of non-programmable calculator is allowed.
 - 4) Assume suitable data if necessary.

SECTION - I

Q1) Attempt any Three of the following.

- a) Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = 3\sin x + 4\cos x$ with $y(0) = 1$ and $y'(0) = 0$. [6]
- b) Solve $(D^2 + D + 1)y = (1 - e^x)^2$ [6]
- c) Solve $(D^2 + 5D + 4)y = 3 - 2x$ [6]
- d) Solve $x^2 \frac{d^2y}{dx^2} + 4x \frac{dy}{dx} + 2y = e^x$. [6]

Q2) Attempt any one of the following.

- a) The whirling speed of a shaft of length l is given by $\frac{d^4y}{dx^4} - a^4y = 0$,

where $a^4 = \frac{Ww^2}{gEI}$ and y is the displacement at distance x from one end. If

the ends of the shafts are considered in long bearing so that the slope at each end is zero, show that the shaft will whirl when $\cos al \cosh al = 1$. [16]

P.T.O.



- b) i) The motion of particle is given by $\frac{d^2s}{dt^2} + k^2 \frac{ds}{dt} = 0$. At $t = 0$,

$$s = s_0 \text{ and } \frac{ds}{dt} = v_0 \text{ show that as time } t \rightarrow \infty, s = s_0 + \frac{v_0}{k^2} \quad [8]$$

ii) A spring for which stiffness $K = 700$ Newton / m hangs in a vertical position with its upper end fixed. A mass of 7 kg is attached to the lower end. After coming to rest, the mass is pulled down to 0.05 m and released. Discuss the resulting motion of the mass, neglecting air resistance. [8]

Q3) Attempt any two of the following.

- a) If $\vec{a}$ is a constant vector, $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ and $r = \sqrt{x^2 + y^2 + z^2}$ then find

$$i) \nabla \cdot \left(\frac{\vec{a} \times \vec{r}}{r} \right) \text{ and show that } ii) \nabla r^n = nr^{n-2} \vec{r} \quad [8]$$

- b) Show that $\vec{F} = (z^2 + 2x + 3y)\vec{i} + (3x + 2y + z)\vec{j} + (y + 2xz)\vec{k}$ is irrotational but not solenoidal and hence find scalar potential [8]

- c) Find the directional derivative of $\phi = x^2 + 2y^2 - 3z^2$ at $(1, 2, 1)$ in the direction [8]

- i) Normal to $xy^2 + yz^3 = 4$ at $(1, -1, 1)$
 ii) tangent to $x = t^2 + t, y = 2t, z = 2 - t$ at $t = 1$

SECTION - II

Q4) Attempt any three from the following:

- a) Find the Laplace transform of $\frac{d}{dt} \left(\frac{\sin t}{t} \right)$ [6]

- b) Find $L \left\{ \int_0^t x \cosh x dx \right\}$ [6]

- c) Find inverse Laplace transform of $\log \left(1 + \frac{a^2}{s^2} \right)$ [6]

- d) A particle is moving along x-axis according to the law $\frac{d^2x}{dt^2} + 6 \frac{dx}{dt} + 25x = 0$. If the initial velocity is 12 meters per second to the left, determine x in terms of t using Laplace transform method. [6]

Q5) Attempt any Two of the following:

- a) A function $f(x)$ is defined within the range $(0, 2\pi)$ as [8]

$$f(x) = \begin{cases} x & \text{if } 0 < x < \pi \\ 2\pi - x & \text{if } \pi < x < 2\pi \end{cases}$$

Express $f(x)$ as a Fourier series in the range $(0, 2\pi)$

- b) Find Fourier series with period 3 to represent $f(x) = 2x - x^2$ in the range $(0, 3)$ [8]

- c) Find half range cosine series for $f(x) = \sin x$ in the range $(0, \pi)$ and hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$. [8]

Q6) Attempt any one from the following.

- a) Solve $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$ if $u(x, t)$ satisfies the following conditions. [16]

i) $u(0, t) = 0$ for all t

ii) $u(l, t) = 0$ for all t

iii) $u(x, 0) = \begin{cases} x & \text{if } 0 \leq x \leq l/2 \\ l - x & \text{if } l/2 \leq x \leq l \end{cases}$