QTS

2009

MECHANICAL ENGINEERING- I (Optional)

100083

Standard : Degree **Total Marks : 200**

Nature : Conventional **Duration : 3 Hours**

Note :

*(i) Answers must be written in **English**.*

*(ii) Question **No. 1** is **Compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each section.***

*(iii) Figures to the **RIGHT** indicate marks of the respective question.*

(iv) Use of log table, Non-programmable calculator is permitted, but any other Table / Code / Reference book are not permitted.

(v) Make suitable assumptions, wherever be necessary and state the same.

(vi) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.

(vii) Credit will be given for orderly, concise and effective writing.

(viii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.

Marks

1. Answer ***any four*** of the following :

(a) Considering a bar of uniform cross section subjected to a sudden load, show that stress induced in this case is twice the stress induced when same load is applied gradually. **10**

(b) Centrifugal clutch transmitting 20 kW at 750 rpm consist of four shoes. The clutch is to be engaged at 500 rpm. The inner radius of drum is 165 mm while radius of centre of gravity of shoes in engaged position is 140 mm. The coefficient of friction is 0.3. Calculate mass of each shoe. **10**

(c) (i) How much force will be required to pierce a circular hole of diameter 20 mm in a 2 mm thick plate of mild steel with the help of flat ended die and punch in a press tool ? The shear strength of the work material is 350 MPa. **5**

(ii) Describe the process of 'Arc welding with coated electrodes' with a neat sketch. **5**

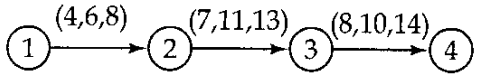
P.T.O.

Marks

(d) Explain Bezier curve with neat sketch. What are the characteristics of Bezier curve. **10**

(e) (i) What is operations Research ? How do you solve a maximization problem as a minimization problem ? **5**

(ii) Determine the expected completion time and the variance of completion time for the network shown in figure (the optimistic, most likely and pessimistic time estimates are shown for each activity). **5**



SECTION - A

2. Answer the following sub-questions :

(a) State the theorem of parallel axis. Consider a strip of a circle whose moment of inertia is required to be found out about a line at distance **h** from centre of gravity. **15**

(b) (i) What is gyroscopic effect ? **15**

(ii) Define - spin axis, gyroscopic couple axis and precision axis.

(iii) Discuss the gyroscopic effect on a ship.

(c) (i) A simply supported beam 6 m long is carrying UDL of 5 kN/m over a length of 3 m from right end. Draw the nature of shear force and bending moment diagram for beam. Calculate the reactions at both ends. **5**

(ii) State and explain unique property of cast Iron. Explain the factors affecting graphitization tendency of Cast iron. **5**

3. Answer the following sub-questions :

(a) Centrifugal clutch consist of four shoes each having a mass of 1.5 kg. In the engaged position the radius of centre of gravity of shoe is 110 mm while innor radius of drum is 140 mm. The coefficient of friction is 0.3. The preload in spring is adjusted in such a way that the spring force at beginning of engagement is 700 N. The running speed is 1440 rpm. Calculate the speed at which engagement begins and power transmitted by clutch at 1440 r.p.m. **15**

(b) (i) Explain viscosity, kinematic viscosity, dynamic viscosity. **15**

(ii) What are important properties of Gear oil ? How are these properties obtained ?

(c) (i) Draw stress - strain diagram for tension test and discuss salient features. **5**

(ii) Write in details phase transformation reactions existing in Fe-c phase diagram. Which reaction is controlled during heat treatment of steels ? Why ? **5**

Marks

SECTION - B

4. Answer the following sub-questions :

(a) Compare the weight of equal length of hollow shaft and solid shaft to transmit a given torque for same maximum shear stress. The material for both shaft is same and inside diameter is 2/3 of outside diameter of hollow shaft. **15**

(b) A triple ply belt conveyor is required to transport 2 ton of iron ore per hour through a distance of 1000 m. and to a height of 300 m. The permissible belt speed is 90 m/min. If mass density of iron ore is 2.5 ton per cubic meter. Determine belt width, diameter of pulley and reduction ratio of gear reducer if electric motor speed is 1440 r.p.m. use following data : **10**

flow ability factor k

Belt inclination $\alpha°$	10 - 15	16 - 20	21 - 25	26 - 30	31 - 35
Flow ability factor $k \times 10^{-4}$	2.65	2.5	2.35	2.20	2.05

Std. belt width mm 400, 450, 500, 600, 650, 750, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000.

Material factor for plies for capron belt $k_1 = 2.0$

Belt tension and arc of contact factor $k_2 = 80$.

(c) What is interference in gear ? List various ways of avoiding interference. Determine the number of teeth required on a pinion in order to avoid interference with gear, with : **15**

(i) A wheel to give a gear ratio 3 to 1.

(ii) An equal wheel.

5. Answer the following sub-questions :

(a) A standard splined connection $8 \times 52 \times 60$ is used for Gear and Shaft assembly of gear box. A 20 kW power at 300 rpm is transmitted by the splines. The normal pressure on splines is limited to 6.5 N/mm^2. The coefficient of friction is 0.6. Calculate length of hub of the gear and force required to shift the gear. **15**

(b) List and explain principles considered in selection of material handling equipment in a layout. (at least 10 principles to be discussed). **10**

(c) What is vibration isolation and force transmissibility ? A refrigerator unit of 30 kg mass is to be supported by three springs. The unit operates at 500 rpm. If 10% of shaking force of refrigerator unit is to be transmitted to supporting structure determine the spring constant. **15**

Marks

(ii) The cost of a machine is Rs. 6100 and its scrap value is only Rs. 100. The maintenance costs are found from experience to be : 6

Year	:	1	2	3	4	5	6	7	8
Maintenance cost in Rs.	:	100	250	400	600	900	1250	1600	2000

When should the machine be replaced ?

SECTION - D

8. Answer the following sub-questions :

(a) What is QFD ? Explain various steps of QFD ? 10

(b) What is machine tool vibrations ? Explain various isolation systems used. Also explain vibration absorber model. 15

(c) (i) Explain step by step procedure to manufacture components on CNC machines. 7

(ii) Explain preparatory codes G01, G02 with suitable examples. 8

9. Answer the following sub-questions :

(a) What are different activities involved in product development ? Discuss design for manufacturing (DFM). 10

(b) What are the different mechanisms used for converting rotary to linear motion ? Explain any one method in detail with neat sketch. 15

(c) What is a need of computer aided process planning ? Classify a component using optiz system. 15

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SECTION - C

6. Answer the following sub-questions :

(a) (i) The Taylorian tool-life equation for machining C-40 steel with a 18 : 4 : 1 HSS cutting tool at a feed of 0.2 mm/min and a depth of cut of 2 mm is given by $VT^n = C$, where 'n' and 'C' are constants. The following V and T observations have been noted : 8

V, (m/min)	25	35
T, (min)	90	20

Calculate : (A) n and C

(B) Hence recommend the cutting speed for a desired tool life of 60 min.

(ii) Draw schematic diagram of Electro - Discharge Machining (EDM) process and explain the effect of process parameters on metal removal rates, surface finish and accuracy on the workpiece. 7

(b) (i) Demand for a auto-part is shown below. Our forecast for April was 100 units. With a smoothing constant of 0.20 and using first order exponential smoothing, what is the July forecaset ? What do you think about a 0.20 smoothing constant ? 5

(ii) How can Pareto Analysis be used effectively as a diagnostic tool in quality improvement ? Explain. 5

(c) (i) The payoff matrix of a game is given. Find the solution of the game to the player A and B. 8

		B				
		I	II	III	IV	V
A	I	−2	0	0	5	3
	II	3	2	1	2	2
	III	−4	−3	0	−2	6
	IV	5	3	−4	2	−6

(ii) What do you understand by a optimum service rate ? Show how some important queueing formulae are used in determining the optimum service rate and the number of channels. 7

P.T.O.

Marks

7. Answer the following sub-questions :

(a) (i) What is meant by 'Fool Proofing' as applied to Jigs and Fixtures ? How it can be achieved ? 6

(ii) For a turning operation with HSS tool for hot rolled 0.2% C - steel, the following data is given : 9

Cutting speed = 0.2 m/s

Depth of cut = 3.2 mm

Feed = 0.5 mm/rev

C_s = 15°

Determine = Cutting power, motor power, specific cutting resistance and unit power.

(b) (i) A private hospital purchases a wide variety of life saving drugs, out of which quite a few have limited shelf life. One of the life saving drugs which costs Rs. 1.80 per bottle is required at an average rate of 60 bottles per month. The cost to replenish the stock of an item and the cost of holding inventories, as computed by the hospital authorities, are Rs. 24 per order and 12% respectively. 5

(A) Calculate theoretical order quantity of the drug.

(B) If the drug has a limited shelf life of 4 months, what quantity should be purchased at a time ?

(ii) Describe what is meant by statistical process control ? Why are control charts made ? How are they used ? 5

(c) (i) A car hire company has one car at each of five depots a, b, c, d and e. A customer requires a car in each town, namely A, B, C, D and E. Distances (in kms) between depots (origins) and towns (destinations) are given in the following distance matrix : 9

	a	b	c	d	e
A	160	130	175	190	200
B	135	120	130	160	175
C	140	110	155	170	185
D	50	50	80	80	110
E	55	35	70	80	105

How should cars be assigned to customers so as to minimize the distance travelled ?

P.T.O.