USN | | | | | | | | | | 10ME62

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
2. Use of design data hand book is permitted.
3. Any missing data can be assumed suitably and stated.

PART – A

1 a. A crane hook of trapezoidal cross section whose inner and outer sides are 60mm and 30mm has a depth of 64mm. The centre of curvature is at a distance of 90mm from the inside of the beam. Determine the maximum tensile and compressive stresses induced in the crane hook when its lifting capacity is 60kN. **(12 Marks)**

b. A compound cylinder is made by shrinking a cylinder of external diameter 300mm and internal diameter of 250mm over another cylinder of external diameter 250mm and internal diameter 200mm. If the radial pressure at the junction is $8N/mm^2$, determine using Lame's equations, the stresses at outer and inner surfaces of the outer cylinder. **(08 Marks)**

2 a. Select a V-belt drive to transmit a load of 6kW from a shaft rotating at 1000rpm to a parallel shaft to be rotated at 350rpm. The space limits the centre distance between shafts to 500mm. The pitch diameter of the smaller pulley could be assumed to be 150mm. **(10 Marks)**

b. A 6 × 19 wire rope is used to lift a load of 10kN of iron ore from a mine of 600 metre deep. The weight of the bucket is 2kN. The maximum speed of 50m/min is attained in 1 second. Find diameter of the wire rope, assuming factor of safety as 6. **(10 Marks)**

3 a. Derive an expression for stress induced in a helical coil spring. **(05 Marks)**

b. What is surging in springs and how it can be overcome? **(03 Marks)**

c. A semi elliptical laminated leaf spring with two full length leaves, ten graduated leaves are to be designed to support a central load of 6kN over two points 1 metre apart. The central band width is 100mm. The ratio of total depth of spring to its width is 2.5. Maximum normal stress in the material of leaves is 400MPa and modulus of elasticity is 208GPa. Determine:
i) Width and thickness of leaves.
ii) The initial gap between full length and graduated leaves.
iii) Central bolt load. **(12 Marks)**

4 a. Write a note on applications of gear drives. **(04 Marks)**

b. Design a pair of spur gears to transmit 20kW of power while operating for 8 to 10 hrs. per day sustaining medium shock from a shaft rotating at 1000rpm to a parallel shaft which is to rotate at 310rpm. Assume the number of teeth on pinion to be 31 and 20° full depth involute tooth profile. The material for pinion is C40 steel whose σ_b = 206.8MPa and for gear is cast steel whose σ_b = 137.3MPa. Check the design for wear and dynamic load. Assume load factor, C = 522.46 N/mm and load stress factor, K = $0.279 N/mm^2$. **(16 Marks)**

PART – B

5 a. Mention the advantages and disadvantages of worm gear drive. (04 Marks)

b. Design a pair of right angle bevel gears to transmit 8.5kW at 1500 rpm of pinion. The velocity ratio is 5:1. Pinion is made of cast steel and gear of high grade cast Iron with allowable static stresses as 120MPa and 93MPa respectively. The teeth are 20° stub involute, pinion has a pitch diameter of 90mm. (16 Marks)

6 a. Design a cone clutch to transmit a power of 40kW at a rated speed of 750rpm. Also determine:

i) Axial force necessary to transmit torque

ii) Axial force necessary to engage the cone clutch. Assume coefficient of friction = 0.3, cone angle = 20°. (10 Marks)

b. A single band brake operates on a drum 600mm in diameter that is running at 200rpm while absorbing 15kW of power. The coefficient of friction is 0.25. The brake band has a contact of 270° and one end is fastened to a fixed pin and the other end to the brake arm 125mm from the fixed pin. Straight arm is 750mm long and is placed perpendicular to the diameter that bisects the angle of contact. Determine maximum effort required to stop the rotation of drum. (06 Marks)

c. Classify the brakes and name different types of mechanical brakes. (04 Marks)

7 a. Derive Pettroff's equation, with usual notations. (08 Marks)

b. It is required to design a main bearing of a 4-stroke engine to sustain a load of 6kN over a shaft of diameter 50mm. The operating speed of the shaft is 1000rpm and operating temperature is 50°C. Assuming absolute viscosity as 33 CP, determine:

i) Length of bearing

ii) Coefficient of friction

iii) Heat generated

iv) Heat dissipated

v) State whether artificial coding is necessary

vi) Sommerfield number. (12 Marks)

8 a. Explain the considerations given in the design of crank shaft of an IC Engine. (04 Marks)

b. Design a connecting rod for a I.C. engine with the following data:
Diameter of piston = 110mm
Stroke = 160mm
Explosion pressure = 3.5MPa
Engine speed = 2000 rpm
Weight of reciprocating parts = 20N
Material C50 steel,
Length of connecting rod = 320mm
(Assume bolt material as C50 steel and factor of safety as 3). (16 Marks)

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10ME63

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Heat and Mass Transfer

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
2. Use of heat transfer data hand book is permitted.

PART – A

1 a. Derive the general three-dimensional conduction equation in Cartesian coordinates and mention the assumptions made. **(08 Marks)**

b. What do you mean by initial and boundary conditions of the three kinds? **(04 Marks)**

c. The diagram in Fig.Q.1(c) shows a conical section made of a material with K = 3.46 W/m.K. It is of circular cross section with diameter D = ax, where a = 0.25 and x is the distance measured from the apex of the cone. The smaller diameter end is at x_1 = 50mm and the larger diameter end is at x_2 = 250mm with the corresponding temperatures being T_1 = 400K and T_2 = 600K. The lateral surface of the cone is well insulated.

i) Derive an expression for the temperature distribution T(x) assuming one dimensional steady state condition in x-direction only.

ii) Calculate the rate of heat transfer through the cone. **(08 Marks)**

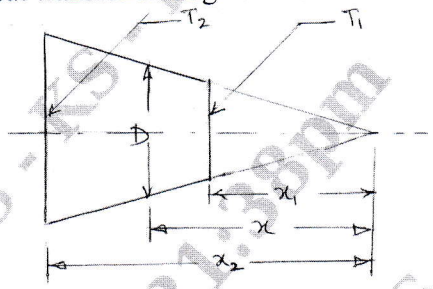

Fig.Q.1(c)

2 a. Obtain an expression for heat transfer through a plane wall in which thermal conductivity is given by $K = K_0 [1 + \beta T]$, where β is constant, K_0 thermal conductivity at some reference temperature and T is the temperature. **(08 Marks)**

b. An electric cable of 10mm diameter is to be laid in atmosphere at 20°C. The estimated surface temperature of the cable due to heat generation is 65°C. Find the maximum percentage increase in heat dissipation when the wire is insulated with rubber having K = 0.155 W/mK. Take h = 8.5W/m^2K. **(06 Marks)**

c. One end of a long aluminum rod is connected to a wall at 140°C; while the other end protrudes into a room whose air temperature is 15°C. The rod is 3mm in diameter and the heat transfer coefficient between the rod surface and environment is 300W/m^2 °C. Estimate the total heat dissipated by the rod taking its thermal conductivity as 150W/m °C. **(06 Marks)**

3 a. A mild steel sphere of 15mm in diameter initially at 625°C is exposed to a current of air at 25°C with convection coefficient of 120W/m^2K. Calculate:

i) Time required to cool the sphere to 100°C

ii) Initial rate of cooling in °C/S

iii) Instantaneous heat transfer rate at the end of one minute after the start of cooling

Take properties of mild steel as

K = 43W/m.K ρ = 7850kg/m^3

C = 474J/kg.K α = 0.045m^2/s. **(10 Marks)**

b. A large slab of wrought iron is at a uniform temperature of 375°C. The temperature of one surface of this slab is suddenly changed to 75°C. Calculate the time required for the temperature to reach 275°C at a depth of 5cm from the surface and the quantity of energy transferred per unit area of the surface during this period. Take K = 60W/mK and $\alpha = 1.626 \times 10^{-5}$ m^2/s. **(10 Marks)**

4 a. What do you mean by hydrodynamic and thermal boundary layer? How does the ratio δ/δ_t vary with Prandtl number. **(06 Marks)**

b. Distinguish between laminar and turbulent flow. **(04 Marks)**

c. Air at 20°C and at a atmospheric pressure flows over a flat plate at a velocity of 3m/s. If the plate is 30cm length and at a temperature of 60°C, calculate:

i) Velocity and thermal boundary layer thickness at 0.3m
ii) Average heat transfer coefficient
iii) Total drag force on the plate, per unit width

Take the following properties of air

$\rho = 1.18$kg/cm^3, $\upsilon = 17 \times 10^{-6}$m^2/s, k = 0.0272W/mK, $C_p = 1.007$kJ/kg K, $P_r = 0.705$ **(10 Marks)**

PART – B

5 a. With the help of dimensional analysis, derive expression for the Reynolds number, Prandtl number and Nusselt number. **(10 Marks)**

b. Assuming that a man can be represented by a cylinder 30cm in diameter and 1.7m high with a surface temperature of 30°C. Calculate the heat he would lose while standing in a 36km/h wind at 10°C. **(10 Marks)**

6 a. Derive an expression for effectiveness of parallel flow heat exchanger. **(10 Marks)**

b. Calculate the surface area required for a heat exchanger which is required to cool 3200kg/hr of benzene, $C_p = 1.74$kJ/kg °C, from 72°C to 42°C. The cooling water $C_p = 4.18$kJ/kg°C at 15°C has a flow rate of 2200kg/hr, for the cases,

i) Single pass counter flow
ii) 1-4 exchange (one shell pass and 4-tube passes)

Overall heat transfer coefficient for each configuration, U = 0.28 kW/m^2 °C. **(10 Marks)**

7 a. Sketch a pool boiling curve for water and explain briefly various regimes in boiling heat transfer. **(08 Marks)**

b. Write a short note on filmwise and dropwise condensation. **(04 Marks)**

c. Dry saturated steam at a pressure of 2.45 bar condenses on the surface of a vertical tube of height 1m. The tube surface temperature is kept at 117°C. Estimate the thickness of condensate film and local heat transfer coefficient at a distance of 0.2m from the upper end of the tube. **(08 Marks)**

8 a. State the following laws of radiation:
i) Plank's law ii) Kirchoff's law iii) Wein's displacement law **(06 Marks)**

b. Explain the following:
i) Absorptivity ii) Reflectivity iii) Transmissivity **(06 Marks)**

c. An industrial furnace in the form of a black body emits radiation at 3000K. Calculate the following:

i) Mono chromatic emissive power at 1 μm wave length
ii) Wavelength at which the emission is the maximum
iii) Maximum emissive power
iv) Total emissive power. **(08 Marks)**

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10ME64

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. *Missing data may be assumed suitably.*

PART – A

1 a. Explain basic steps in Finite Element Method. (06 Marks)

b. Explain equilibrium equations in elasticity subjected to body and traction forces. (06 Marks)

c. Explain node numbering scheme and its effect on the half bandwidth. (08 Marks)

2 a. State the principle of minimum potential energy. Determine the displacements at nodes for the spring system shown in Fig Q2(a), Take : $K_1 = 50N/mm$; $K_2 = 60N/mm$; $K_3 = 70N/mm$ $F_1 = 75N$; $F_2 = 100N$.

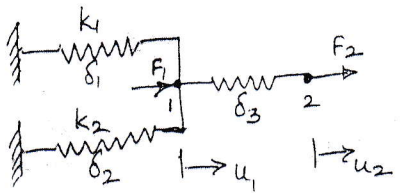

Fig Q2(a) (08 Marks)

b. Write the properties of stiffness matrix and derive the element stiffness matrix for a 1D bar element using direct stiffness method. (08 Marks)

c. Write a note on Galerkin's method. (04 Marks)

3 a. Write a note on the polynomial involved in linear, quadratic and cubic 10 elements. (06 Marks)

b. Derive shape functions for 2D Triangular element in Natural coordinate. (06 Marks)

c. Derive shape functions for 2D Rectangular element in Natural coordinate. (08 Marks)

4 a. Fig Q4(a), show a bar subjected to a UDL of $P_0 = 100N/m$, Take $E = 70GPA$, Area $(A) = 10^4 mm^2$ to determine : i) Nodal displacements ii) Stress in element.

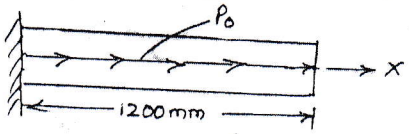

Fig Q4(a) (08 Marks)

b. Determine the nodal displacement, stress in each element and support reaction in the bar shown in Fig Q4(b) due to the applied force P = 100kN, Take $E_{steel} = 200GPa$, $E_{copper} = 100GPa$.

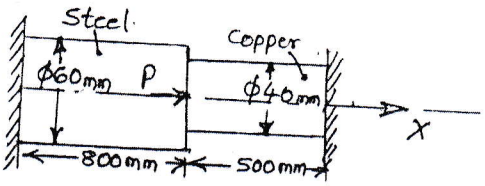

Fig Q4(b) (12 Marks)

PART – B

5 a. Derive the shape function for a quadratic bar element using Lagrange's interpolation. (06 Marks)

b. With a sketch define ISO, sub and super parametric elements. (06 Marks)

c. Write a note on 2-point integration rule for 1D and 2D problems. (08 Marks)

6 a. Obtain an expression for stiffness matrix of a truss element. (08 Marks)

b. Determine the nodal displacement and stress in each element for the truss shown in Fig Q6(b), Take E = 210GPA, A = 0.01m^2.

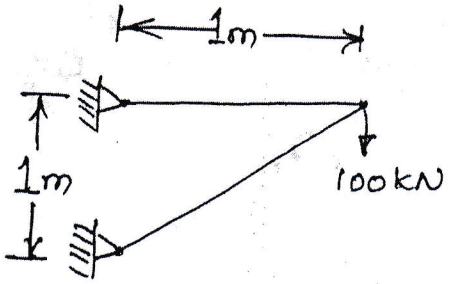

Fig Q6(b)

(12 Marks)

7 a. Define Hermite shape functions. Derive Hermite shape functions for the beam element. (10 Marks)

b. Derive stiffness matrix for the beam element using Hermite shape functions. (10 Marks)

8 a. Derive conductivity matrix for a 1-D bar element with 2 nodes. (06 Marks)

b. Compute the temperature distribution in the composite wall Fig Q8(b), using 1D heat elements. Use penalty approach of handling boundary conditions. Data: K_1 = 20 W/m°C ; K_2 = 30 W/m°C ; K_3 = 50 W/m°C ; T_∞ = 800°C ; h = 25 W/m^2 °C, T_0 = 20°C.

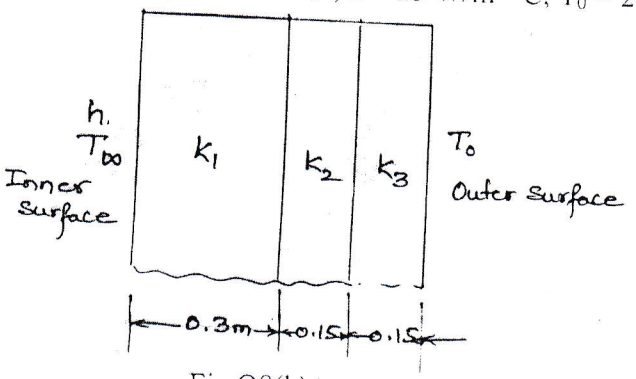

Fig Q8(b)

(14 Marks)

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10ME65

Sixth Semester B.E. Degree Examination, Jan./Feb.2021
Mechatronics and Microprocessor

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define Mechatronics. Discuss advantages and disadvantages of Mechatronics system. (05 Marks)

b. Briefly explain the elements of closed loop control system. (06 Marks)

c. Explain with the block diagram, working of the washing machine. (09 Marks)

2 a. Explain static and dynamic characteristics of sensors. (06 Marks)

b. Explain the principle of Hall effect sensor with example. (08 Marks)

c. Explain capacitive element sensor. (06 Marks)

3 a. Explain Permanent magnet type DC motor with schematic diagram. (08 Marks)

b. Name any four solid state switches and explain each in brief. (12 Marks)

4 a. With block diagram, explain data acquisition system. (10 Marks)

b. Explain inverting and non-inverting op-amp with a neat sketch. (10 Marks)

PART – B

5 a. With the help of symbol and truth table, explain AND, OR, XOR and NAND gates. (08 Marks)

b. Convert the following:

(i) $(154)_{10} = (\_\_\_\_\_)_2 = (\_\_\_\_\_)_{16}$

(ii) $(10001011)_2 = (\_\_\_\_\_)_{16}$. (03 Marks)

c. State and prove De-Morgan's theorem. Also draw the logic circuit for the same. (09 Marks)

6 a. With a neat sketch, explain internal architecture of Intel 8085 processor. (14 Marks)

b. What are the differences between microprocessors and microcontrollers? (06 Marks)

7 a. Explain different types of instruction sets of 8085 microprocessor. (12 Marks)

b. What are Buses? Explain types of Buses available in 8085 microprocessor. (08 Marks)

8 a. Draw and explain the timing diagram for memory write operation. (10 Marks)

b. Draw and explain flow of instruction word and data word. (10 Marks)

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10ME61/10ME617

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

1 a. Define the terms 'Automation' and 'CIM'. Explain the relationship between these two terms with a simple sketch. **(06 Marks)**

b. Explain the mathematical modeling of the following production concepts for different types of production: (i) MLT (ii) Production rate **(10 Marks)**

c. A production machine operates 80 hrs/week at full capacity. Its production rate is 20 units/hr. During a certain week, the machine produced 1000 parts and was idle the remaining time.
i) Determine the production capacity of the machine
ii) What was the utilization of the machine during the week under consideration? **(04 Marks)**

2 a. Write the classification of work part transport based on the type of motion imported to the work piece by transfer mechanism. Explain them with the help of velocity-distance diagrams. **(10 Marks)**

b. What is a Buffer storage? Write the schematic of a Buffer storage between two stages of an APL. List the reasons for using a Buffer storage in an APL. **(10 Marks)**

3 a. Explain the following terms used in the analysis of automated flow line:
(i) Average downtime (ii) Line efficiency
(iii) Upper Bound Approach (iv) Lower Bound Approach **(04 Marks)**

b. A 30 station transfer line has an ideal cycle time of 0.75 min, and average downtime of 6 min/line stop and a station failure frequency of p = 0.01 for all stations. A proposal has been submitted to locate a storage buffer between stations 15 and 16 to improve line efficiency. If the capacity of storage buffer is 20 parts, determine:
(i) Line efficiency (ii) Production rate of the line.
Use upper Bound Approach and assume that the downtime is a constant. **(12 Marks)**

c. What are partially automated flow lines? What are the two important reasons for the occurrence of partially automated flow lines? **(04 Marks)**

4 a. What is Line Balancing? Enumerate four important objectives of line balancing. **(06 Marks)**

b. Explain precedence constraints and precedence diagram. **(04 Marks)**

c. A single model assembly line has to produce a component which has a annual demand of 1,20,000 units/year. The line will operate 48 wk/yr, 6 shifts/wk and 8 hours/shift. Manning level will be one worker per station. The work content is reduced to its corresponding work elements as listed in table. The efficiency of the line is 96% and repositioning time per cycle will be 0.06 min. Determine:
(i) Total work content time (ii) Hourly production rate to achieve the demand
(iii) Cycle time (iv) Theoretical minimum number of workers required
(v) Service time to which the line must be balance

Sl. No. (element)	1	2	3	4	5	6	7	8	9	10	11	12
T_e (min)	0.3	0.4	0.8	0.1	0.2	0.15	0.38	0.6	0.5	0.25	0.18	0.32
Preceded by	-	-	1	1,2	2	3	3	3,4	6,7,8	5	9,10	11

Construct the precedence diagram. **(10 Marks)**

PART – B

5 a. With neat sketches, explain the classification of automated assembly systems according to physical configuration. **(12 Marks)**

b. A single station assembly machine performs 5 work elements to assemble 4 components to a base part. The elements are listed in the table below, together with the fraction defect rate (q) and probability of a station jam (m) for each of the component added.

Element	Operation	Time (sec)	q	m	p
1	Add gear	4	0.02	1.0	-
2	Add spacer	3	0.01	0.6	-
3	Add gear	4	0.015	0.8	-
4	Add gear and mesh	7	0.02	1.0	-
5	Fasten	5	0	NA	0.012

Time to load the base part is 3 sec and time to unload the completed assembly is 4 sec, giving a total load/unload time of T_h = 7 sec. when a jam occurs it takes an average of 1.5 mins to clear the jam and restart the machine. Determine:

(i) Production rate of all products
(ii) Yield of good product
(iii) Production rate of good products
(iv) Uptime efficiency of the assembly machine **(08 Marks)**

6 a. Explain Retrieval CAPP system with the help of a block diagram. **(12 Marks)**

b. What is MRP? Explain the inputs to the MRP system. **(08 Marks)**

7 a. Write a note on universal machining centre. **(04 Marks)**

b. List the steps involved in the development of a part program. **(08 Marks)**

c. Explain the following with respect to CNC part programming:

(i) Preparatory function
(ii) Absolute positioning
(iii) Incremental positioning
(iv) Miscellaneous functions **(08 Marks)**

8 a. Explain Robot configurations with the help of neat sketches. **(12 Marks)**

b. Explain different external sensors used in robots. **(08 Marks)**

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10ME665

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Non-Traditional Machining

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Can "Non Traditional Machining" processes replace conventional process? Justify your answer with reference to the following:
i) Technical feasibility. ii) Economic considerations. **(07 Marks)**

b. Explain the need and characteristic features of Non Traditional Machining. **(06 Marks)**

c. What do you understand by the term "Ultrasonics"? Explain with simple, sketch, the principle of operation of ultrasonic machining. **(07 Marks)**

2 a. Discuss the effect of the following parameters on the rate of material removal and surface finish obtainable in ultrasonic machining:
i) Amplitude and frequency of vibration. ii) Abrasive grain size. iii) Static load. **(10 Marks)**

b. List out the advantages, disadvantages and applications of USM. **(10 Marks)**

3 a. Sketch the setup for "Abrasive Jet Machining" process. State the main elements of the process and write two important features of each element. **(10 Marks)**

b. Explain the following variables that influence the rate of metal removal and accuracy of machining in Abrasive Jet Machining.
i) Stand off distance ii) Abrasive flow rate iii) Nozzle pressure iv) Mixing ratio **(10 Marks)**

4 a. Explain with a neat sketch, the Electro Chemical Machining (ECM) process. **(08 Marks)**

b. Explain the elements of ECM. **(08 Marks)**

c. What are the functions of electrolyte? Mention any two electrolytes used in ECM Process. **(04 Marks)**

PART – B

5 a. Explain the sequence of operation in chemical machining process. **(07 Marks)**

b. List the factors to be considered in the selection of etchants in chemical machining. **(05 Marks)**

c. Discuss the following in chemical machining process:
i) Etchants ii) Maskants. **(08 Marks)**

6 a. Explain the working principle of Electrical Discharge Machining (EDM) with a neat sketch. **(10 Marks)**

b. Mention the advantages, disadvantages and applications of EDM. **(10 Marks)**

7 a. With a neat sketch explain briefly the working principle of Plasma Arc Machining. List out the applications of PAM. **(10 Marks)**

b. What are general guidelines for designing the torch for PAM process? **(10 Marks)**

8 Write short notes on the following:
a) Laser Beam Machining b) Electron Beam Machining
c) Dielectric fluids used in EDM. d) Applications of LBM and EBM **(20 Marks)**

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