"UG" END SEMESTER EXAMINATION – MARCH, 2021
3RD YEAR (6TH SEMESTER) – MECHANICAL ENGINEERING

MECHATRONICS & CONTROL
ME 302

[Full Marks: 80] **[Time: 3 hrs.]**

(Q1 is compulsory; Attempt any four from the rest)

1. Write short notes :(Any eight) 5x8

Hall Effect sensor, Optical Encoder, LVDT, MOSFET, RELAYS, 8085 microprocessor, tactile sensor, Piezoelectric sensor, Pyroelectric sensor, Capacitive element, Thyristor, Triacs, Photo diode sensor

2. A) What is mechatronics? What is the significance of mechatronics in modern engineering? 2+5+3
   B) Explain the difference between open-loop and closed loop system?
3. A) What is microcontroller? Distinguish between microprocessor and microcontroller? 2+3+3
   B) List the objective, advantages & disadvantages of mechatronics.
4. A) Explain the function of programmable logic controller? 5+5
   B) Explain the principles of operation of the stepper motor?
5. Briefly describe different performance terminology of transducer? 10
6. (A) Distinguish the term sensor and transducer with example? 2+4+4
   (B) Describe working principle of potentiometer with sketch.
   C) Describe working principle of strain-gauged element with sketch.
7. Explain for a microprocessor the roles of (a) accumulator, (b) status, (c) memory address, (d) program counter registrars. 10

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"UG" END SEMESTER EXAMINATION – AUGUST, 2021
(REGULAR/SYPPLEMENTARY – EVEN SEMESTER)
3RD YEAR (6TH SEMESTER) – MECHANICAL ENGINEERING

Advanced Manufacturing Technology
ME 310

[Full Marks: 80] **[Time: 3hrs]**

Answer any four questions

1) a) Describe the need of advanced manufacturing processes.
   b) Compare conventional machining and advanced machining processes.
   c) Classify the advanced manufacturing processes including finishing and hybrid processes.

5+8+7=20

2) a) What is mixing ratio in AJM process?
   b) Briefly discuss, with suitable graphs, the effect of abrasive flow rate, carrier gas pressure and stand-off distance on material removal rate in AJM process.
   c) During machining in AJM, the material removal rate is found to be 1.5 mm^3/s, the flow rate of abrasive particle is 5 g/min. Calculate the material removal per impact of the abrasives and the radius of indentation if the abrasive grit size is 80 μm. Take density of abrasive particle as 2 g/cm^3.

3+8+9=20

3) a) Describe the material removal mechanism in USM with schematic diagram.
   b) Draw Fish-bone Diagram for the process parameters in USM process.
   c) With graphs, explain the influence of process parameters (i) water flow rate, (ii) stand-off distance and (iii) water pressure on material removal rate (MRR) in WJM.

5+5+10=20

4) a) With graphical plots, explain the effects of (i) water pressure, (ii) abrasive flow rate, (iii) stand-off distance, (iv) traverse speed and (v) number of passes on depth of cut in AWJM process.
   b) Enlist various etchants used in ChM.
   c) Why cleaning of workpiece is necessary in ChM?

10+4+6=20

5) a) Describe the laser generation process with schematic views.
   b) List out the process parameters involves in laser beam machining processes.
   c) State the essential properties of dielectric fluid in EDM.

6+7+7=20

6) Write short notes (any four)
   (i) Laser cutting
   (ii) Laser texturing
   (iii) Dielectric fluid
   (iv) Faraday's laws of electrolysis
   (v) Laser Amplification

5 × 4 = 20

========== END ==========

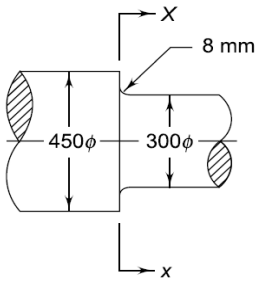
"UG" END SEMESTER EXAMINATION – AUGUST, 2021
(REGULAR/SYPPLEMENTARY – EVEN SEMESTER)
3RD YEAR (6TH SEMESTER) – MECHANICAL ENGINEERING
DESIGN OF MACHINE ELEMENTS - II
ME 304

[Full Marks = 80] **[Time = 3 hours]**

Assume suitable data if not provided.

Answer any four questions **[20 x 4 = 80]**

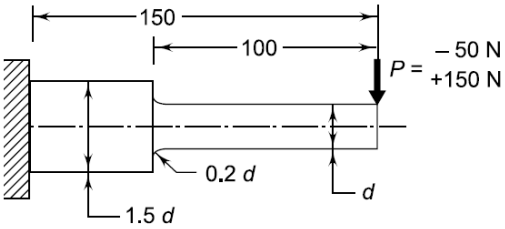
1. The section of a steel shaft is shown in the figure. The shaft is machined by a turning process. The section at XX is subjected to a constant bending moment of $500\ kN-m$. The shaft material has ultimate tensile strength of $500 MN/m^2$, yield point of $350\ MN/m^2$ and endurance limit in bending for a $7.5\ mm$ diameter specimen of $210 MN/m^2$. The notch sensitivity factor can be taken as 0.8. The theoretical stress concentration factor may be interpolated from following tabulated values:



$\left(\frac{r_f}{d}\right)$	0.025	0.05	0.1
K_t	2.6	2.05	1.66

Where, r_f is the fillet radius and d is the shaft diameter. The reliability is 50% ($K_c = 1.0$). Determine the life of the shaft. Given, $K_a = 0.79, K_b = 0.75$ [20]

2. A cantilever beam made of cold drawn steel $40C8$ $\left(S_{ut} = 600\ N/mm^2\right.$ and $\left.S_{yt} = 380\ N/mm^2\right)$ as shown in the figure. The force 'P' acting at the free end varies from $-50\ N$ to $+150\ N$. The expected reliability is 90% and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter 'd' of the beam at the fillet cross-section using Gerber curve as failure criterion.



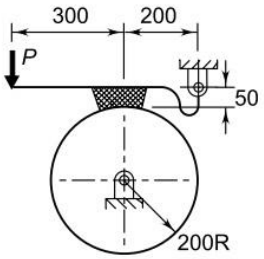
Given, $K_a = 0.77, K_b = 0.85, K_c = 0.897, K_t = 1.44$ and $S'_e = 0.5 S_{ut}$

Also determine the diameter 'd' using Goodman curve as failure criterion considering above conditions. And calculate the percentage difference of diameter with respect to Gerber failure criterion. [15 + 5 = 20]

3. A single plate clutch is designed to transmit 10kW power at 2000rpm. The equivalent mass and radius of gyration of the input shaft are 20 kg and 75 mm respectively. The equivalent mass and radius of gyration of the output shaft are 35 kg and 125 mm respectively. Calculate:

i) The time required to bring the output shaft to the rated speed from rest;
ii) The heat generated during the clutching operation; and
iii) The temperature rise of the system if the specific heat of the clutch assembly is $500\ J/kg^0C$. [8+6+6=20]

4. A single block brake with a torque capacity of 250 N-m is shown in the figure. The brake drum rotates at 100 rpm and the co-efficient of friction is 0.35. Calculate:



i) The actuating force and the hinge-pin reaction for clockwise rotation of the drum;
ii) The actuating force and the hinge-pin reaction for anti-clockwise rotation of the drum;
iii) The rate of heat generated during the braking action.
iv) Justify if it is self-locking or not. [5 x 4 = 20]

5. Following data is given for hydrostatic thrust bearing:

Thrust load = 500 kN Recess diameter = 300 mm
Shaft speed = 720 rpm Film thickness = 0.15 mm
Shaft diameter = 500 mm Viscosity of lubricant = $(29.3)(10^{-9})$N-s/mm^2

Calculate:

a) Supply pressure;
b) Flow requirement in liters/min;
c) Power loss in pumping; and
d) Frictional power loss.
e) If the thrust load is increased to 600 kN, calculate the percentage increase total power with respect to previous total power.

[4 x 5 = 20]

[***p.t.o***]

6. It is required to design a pair of spur gear with 20^0 full-depth involute teeth ($z_p = 18$) based on Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10 kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4:1. The pinion as well as the gear is made of plain carbon steel $40C8(S_{ut} = 600\ N/mm^2)$. The factor of safety can be taken as 1.5. Design the gears, specify their dimensions. Given, Lewis form factor is 0.308 for 18 teeth, pitch line velocity is 5 m/s and ratio (b/m) is 10.
If the module of the gear is in non-integer form, convert into next higher lowest integer and check its feasibility.
Also calculate surface hardness for gears. [8 + 8 + 4 = 20]

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3RD YEAR B. TECH MECHANICAL ENGINEERING

EVEN SEMESTER EXAMINATION, AUGUST-2021

ADVANCED ENGINEERING MATERIALS

ME 308

Full Marks = 80 **Time – 3 hours**

(Answer *any FIVE*)

1. (a) What are composite materials? What are the major applications of composite materials? 2+6
   (b) A continuous and aligned glass-fiber reinforced composite consists of 40 vol% of glass fibers having the Modulus of Elasticity as 69 GPa. And 60 vol% of resin with a Modulus of Elasticity (hardened condition) of 3.4 GPa. Compute the Modulus of Elasticity of the Composite if
   (i) the load is applied in longitudinal direction aligned with fibers
   (ii) the load is applied in transverse direction perpendicular to the fibers 4+4

2. (a) What are ceramics? Explain how ceramics are classified. 2+6
   (b) Compare different ceramic processing techniques. 8

3. (a) Briefly Describe the steps involved in Powder Metallurgy (P/M) process. What are the relative advantages of P/M over other methods of manufacturing? 5+6
   (b) Prove that, the pressure along the length of the compact varies exponentially in Powder Metallurgy compaction 5

4. (a) Briefly explain Atomization process of metal powder production 6
   (b) What are the phases of sintering? How Mechanical Properties are affected by sintering? 6
   (d) What are the limitations of the P/M process? 4

5. (a) Explain why Martensite is so hard and brittle, although it has a same composition of Austenite. 4
   (b) Plot Fe-Fe_3C phase diagram and explain cooling of 0.4%C Plain Carbon steel. 12

6. (a) Why oil is a good quenchant than water for steel? 3
   (b)Why is it difficult to harden low carbon steels? 2
   (c) What are the purpose of heat treatment? 5
   (d) Describe Isothermal Annealing process with TTT diagram. 6

7. Write short notes on (*Any FOUR*): 4X4
   (a) Hybrid Composites
   (b) Slip Casting Process
   (c) HIP and CIP
   (d) Infiltration and Impregnation of P/M products.
   (e) Comparison of Austempering and Martempering
   (f) Flame Hardening

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