| PRN: | | Course Code : | MET 2705.1 |
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Final Year **B. Tech** End Semester Examination Summer 2024

# Design of Mechanical Systems

Day and Date: 9 MAY 2024, Friday  Max Marks: **100**

Time : 10:30AM To 01:30PM  Duration: **03** hrs

Instructions: All questions are compulsory.

| | | | Marks | Bloom's Level | CO |
|---|---|---|---|---|---|
| Q.1 | **Attempt the following** | | | | |
| | a) | Explain the importance of aesthetic design considerations in product design with suitable example. | 08 | 2 | CO1 |
| | b) | Explain relationship between man, machine & environment. | 08 | 1 | CO1 |
| | | OR | | | |
| | b) | Discuss ergonomic considerations in design of displays and controls. | 08 | 2 | CO1 |
| Q.2 | **Attempt the following** | | | | |
| | a) | Explain with neat sketches various types of stresses acting in thin pressure vessels subjected to internal pressure. | 08 | 2 | CO2 |
| | b) | A high pressure cylinder consists of an inner cylinder of inner and outer diameters of 200 and 300 mm respectively. It is jacketed by an outer cylinder with an outside diameter of 400 mm. The difference between the outer diameter of inner cylinder and inner diameter of jacket before assembly is 0.25mm. (E= 207 KN/mm2). Calculate the shrinkage pressure and the maximum tensile stress induced in any of the cylinders. | 08 | 1 | CO2 |
| | | OR | | | |
| | b) | A gas cylinder with an internal diameter of 15 MPa. It is made of plain carbon steel (Syt=230 N/mm2) and factor of safety is 3.0. Calculate the cylinder wall thickness assuming it to be a thin cylinder and neglecting the effect of welded joints. | 08 | 2 | CO2 |
| Q.3 | **Attempt any two from the following** | | | | |
| | a) | Derive the torque transmitting capacity of single plate clutch using uniform pressure theory. | 08 | 2 | CO3 |
| | b) | A multi-disk plate clutch consists of five steel plates and four bronze plates. The inner and outer diameters of the friction disks are 75 mm and 150 mm respectively. The coefficient of friction is 0.1 and the intensity of pressure on friction lining is limited to 0.3 N/mm2. Assuming uniform wear theory, Calculate<br>i) Required force to engage the clutch and<br>ii) Power transmitting capacity at 750 rpm. | 08 | 1 | CO3 |
| | c) | A solid cast iron disk, 2 m in diameter and 0.3 m thick, is used as a flywheel; it is rotating at 500 rpm. It is brought to rest in 2 sec by means of a brake. Calculate the energy absorbed by the brake and the torque capacity of the brake. | 08 | 1 | CO3 |
| Q.4 | **Attempt any two from the following** | | | | |
| | a) | A multispeed gear box is to be designed for a headstock of a turret lathe for nine spindle speeds ranging from 300 rpm to 1000 rpm. If the gear box is driven by 5KW.720 rpm electric motor.<br>1. Draw structure, speed, ray diagram<br>2. Draw gearing diagram | 08 | 2 | CO4 |

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| b) | Explain the advantages of geometrical progression for selecting the speed steps of a multi speed machine tool gear box. | 08 | 1 | CO4 |
| c) | Explain the optimization of structural diagram in the design of a multi -speed machine tool gear box. | 08 | 1 | CO4 |

Q.5 **Attempt any Two of the following**

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| a) | Explain the following terms in Johnson method of optimization.<br>1. Primary Design Equation (PDE)<br>2. Subsidiary Design Equation (SDE)<br>3. Limit Equation (LE) | 09 | 2 | CO4 |
| b) | A shaft is required in a lightweight equipment to transmit a torque of 900Nm and is to have a rigidity of 90 N-m/degree. The F.O.S based on yield strength in shear is 1.5. Using the maximum shear stress theory, design the shaft with the main objective of "MINIMUM WEIGHT" using the following materials | 09 | 1 | CO5 |

| Material | Mass density Kg/m3 | Material cost per unit weight C Rs/N Weight | Tensile Yield strength Syt in MPa | Modulus of Rigidity G, GPa. |
|---|---|---|---|---|
| Alloy steel | 8500 | 16 | 130 | 80 |
| Aluminum alloy | 3000 | 32 | 50 | 26.7 |
| Titanium alloy | 4800 | 480 | 90 | 40 |
| Magnesium alloy | 2100 | 32 | 20 | 16 |

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| c) | Explain the adequate design and optimum design. | 09 | 1 | CO5 |

Q.6 **Attempt any Two of the following**

| | | | | |
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| a) | The cylinder of a four stroke diesel engine as the following specifications<br>Brake power = 3.75 kW<br>Speed = 1000 rpm.<br>Indicated Mean Effect Pressure: 0.35 MPa.<br>Mechanical Efficiency = 80%<br>Determine the bore and length of the cylinder linear | 09 | 2 | CO5 |
| b) | Explain the function of cylinder and advantages of cylinder liner. | 09 | 1 | CO5 |
| c) | Describe the design of connecting rod. | 09 | 1 | CO5 |

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