PES University, Bengaluru
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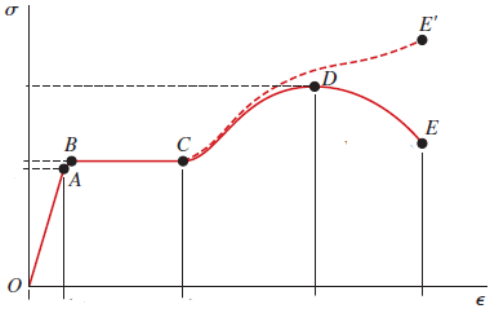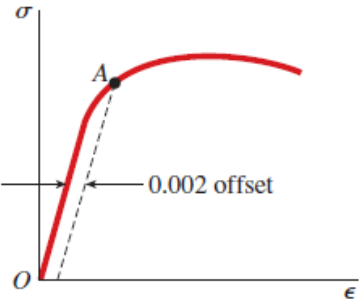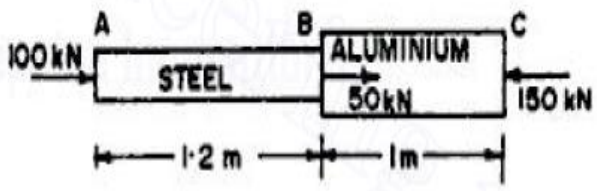
UE21ME131B

JULY 2022: END SEMESTER ASSESSMENT (ESA) B. TECH II SEMESTER

UE21ME131B – MECHANICAL ENGINEERING SCIENCE

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1	a)	The following observations were recorded during a trial of a four-stroke, single-cylinder oil engine. Duration of trial = 30 minutes Oil consumption = 4 litres Calorific value of the oil = 43 MJ/kg Specific gravity of the fuel = 0.8 Average area of the indicator diagram = 8.5 cm^2 Length of the indicator diagram = 8.5 cm Spring constant = 5.5 bar/cm Brake load = 150 kg Spring balance reading = 20 kg Effective brake wheel diameter = 1.5 m Speed = 200 rpm Cylinder diameter = 30 cm Stroke = 45 cm Calculate (i) Indicated power (ii) Brake power (iii) Brake specific fuel consumption in kg/kWh and (v) Indicated thermal efficiency.	8
	b)	Explain the functions of the following components – (i) Draft tube in a Francis turbine (ii) Convergent - divergent nozzle in a De Laval turbine (iii) Heat exchangers in a closed loop gas turbine	6
	c)	(i) List any two differences between flat plate type solar collector and concentrating type solar collector. (ii) A Toyota Prius car model has a compact design without an electrical generator and has a smaller traction motor. Describe the architecture used in the aforementioned hybrid vehicle model with a neat schematic diagram.	6 (2+4)
2	a)	(i) Define (1) Successfully constrained motion (2) Flexible link (ii) Identify and sketch the mechanism used for the following applications – 1) Coupled wheels of a locomotive in which the rotary motion of one wheel is transmitted to the other wheel. 2) Reciprocating engine.	6 (2+4)

	b)	An open belt running over two pulleys of 24 cm and 60 cm diameters, connects two parallel shafts 3 m apart and transmits 3.75 kW from the smaller pulley that rotates at 300 rpm. The coefficient of friction between the belt and the pulleys is 0.3. Determine (i) initial belt tension (ii) length of the belt required.	8
	c)	(i) Axial thrust (force component acting along the axis of the shaft) is absent in case of double helical gears. Justify the statement. (ii) Determine the number of teeth for two toothed wheels to transmit a velocity ratio of 1/4 between two parallel shafts, the centre of which are at a distance of 675 mm. Take module = 15 mm.	6 (2+4)
3	a)	(i) Spring steels are "**resilient**" while structural steels are "**tough**". Bring out the basic difference between the highlighted attributes of the aforementioned materials. (ii) Explain the behaviour of electro/magneto rheological fluids in the presence of the external field.	6 (2+4)
	b)	The following figures show the stress strain curves of mild steel and aluminium specimens respectively, subjected to uniaxial tensile test. Fig.1: Stress Strain curve of Mild Steel Fig.2: Stress Strain curve of Aluminium Describe (i) Region CD and point D of Fig.1 (ii) Point A of Fig.2 (iii) Region DE and point E of Fig. 1 (iv) Curve OABCE' of Fig. 1	8
	c)	A member ABC is formed by connecting a steel bar of 20 mm diameter to an aluminium bar of 30 mm diameter, and is subjected to forces as shown in the following figure. Determine the individual deformations of each portion and total deformation of the bar, taking E for aluminium as 0.7×10^5 N/mm^2 and that for steel as 2×10^5 N/mm^2. 	6

4		(i) In a certain sand casting process of a component made of aluminium alloy, it was observed that the molten aluminium has picked up hydrogen gas from the furnace and the sand in the mould is also having less permeability due to over ramming. Describe the casting defect that would be caused in the above scenario. (ii) Explain loose piece pattern with a neat sketch.	6 (2+4)
	a)		
	b)	Explain the working principle of electric arc welding with a neat sketch.	6
	c)	(i) List any two differences between hot working and cold working processes. (ii) Explain the working principles of forging and drawing with neat sketches.	8 (2+6)
5)	a)	(i) What is the function of lead screw in a centre lathe machine? (ii) Explain the working principles of straddle milling and plain turning operations with neat sketches.	8 (2+6)
	b)	Explain the working principles of counter boring and boring operations with neat sketches.	6 (3+3)
	c)	(i) A flexible automated system is capable of producing a variety of parts (or products) with virtually no lost production time. Justify the statement. (ii) Explain open loop and closed loop control systems.	6 (2+4)