Printed Pages : 7 **TME – 201**

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 4039** Roll No.

# B. Tech.

## (SEM. II) EXAMINATION, 2006-07

## MECHANICAL ENGINEERING

*Time : 3 Hours]* *[Total Marks : 100*

***Note :*** *(1) Answer **all** questions.*

*(2) Use of steam table and Mollier's chart is permitted.*

*(3) Assume missing data if any.*

**1** Attempt any **four** parts of the following : **4×5=20**

a) Explain the concept of continuum, with suitable examples.

b) A closed system whose initial volume is **50 x $10^4$ cc** undergoes a non-flow reversible process for which pressure and volume correlation is given by

**P=(8-4V)** where **p** in bar and **V** in $m^3$ if **200 kJ** of work is supplied to the system. Determine

i. final process

ii. final volume after the completion of process.





c) Steam enters into a steam turbine with a velocity of **30 m/s** and enthalpy of **2610kJ/kg** and leaves with a velocity of **10m/s** and enthalpy of **2050 kJ/kg.** Heat is lost to the surrounding due to temperature, difference is **280 kJ/min** and steam consumption rate of the turbine is **6000 kg/hr.** Stating your assumptions calculate the power developed by the steam turbine.

d) Which is more effective way to increase the efficiency of a reversible heat engine (i) to increase the source temperature $T_1$ while sink temperature $T_2$ kept constant or (ii) to decrease the sink temperature by the same amount while source temperature in constant.

e) What is entropy? When entropy is defined only in terms of reversible process, how can then it be evaluated for an irressible process ?

f) A metal block of **5 kg** and **200°C** is cooled in a surrounding of air which is at **30°C**. If specific heat of metal is **0.4 kJ/kgK** calculate the following:-

i) entropy change of block

ii) entropy change of surrounding & universe.

**2.** Attempt any **two** parts : **10×2=20**

a) i) With the help of neat sketches explain the working of a **4** stroke **SI** engine.

ii) With the help of FS diagrams, explain as to how the Rankine cycle overcomes the limitations of comet vapour cycle for steam turbine power plant.

b) For a steam power plant following observation was made:-

Supply condition of steam : **60 bar 450°C**

Condenser pressure : **0.10 bar**

Steam flow rate : **5000 kg/hr.**

Calculate the following:-

i) Turbine work

ii) % of pump work compared to turbine work

iii) Heat addition in boiler

iv) Heat rejection in condenser

v) Thermal efficiency.

c) An engine working on diesel cycle has air intake condition of **1 bar** and **310° k** and compression ratio is **17**. Heat added at pressure is **1250 kJ/kg**. Make calculation for the maximum temperature of the cycle, net power output and thermal efficiency of the cycle.

**3** Attempt any **two** parts of the following: **10×2=20**

a) Explain the followings:

i) Necessary and sufficient conditions of equilibrium of a system of coplanar concurrent forces.





ii) Concept of free body diagram with the help of suitable examples.

iii) Angle of repose and its applications

iv) Belt friction and its applications.

b) A plate measuring **(4 x 4)m²** is acted upon by **5** forces in its plane as shown in **fig.1**. Determine the magnitude and direction of the resultance force.

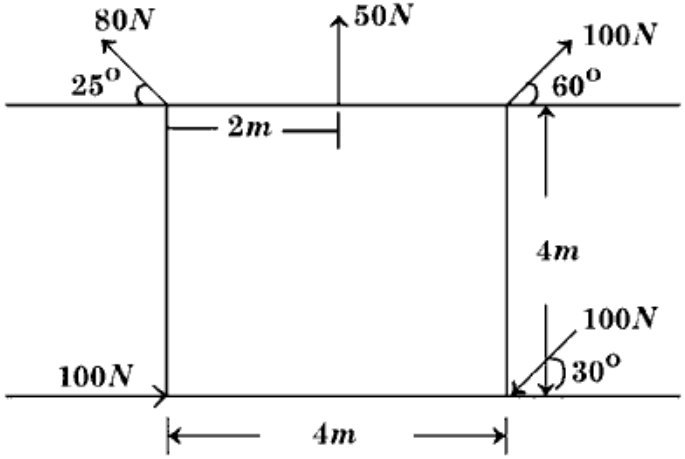


**Fig. 1**

c) A ladder **3 m** long and weighing **250 N** is placed against a wall with end ***B*** at floor level and ***A*** on the wall. In addition to self weight, the ladder supports a man weighing **1200 N** at **2.5 m** from ***B*** on the ladder. If co-efficient of friction at wall is **0.25** and at floor is **0.35** and if ladder makes an angle **60°** with the floor, find the minimum horizontal force which if applied at ***B*** will prevent the slipping of the ladder.

**4** Attempt any **two** parts : **10×2=20**

a) i) Define and differentiate between a perfect, deficient and redundant truss.

ii) Derive the relationship between shear force, bending moment and the loading for a beam. What are the assumptions required for this derivation?

b) Determine the magnitude and nature of forces with the members of truss shown in **fig. 2**.

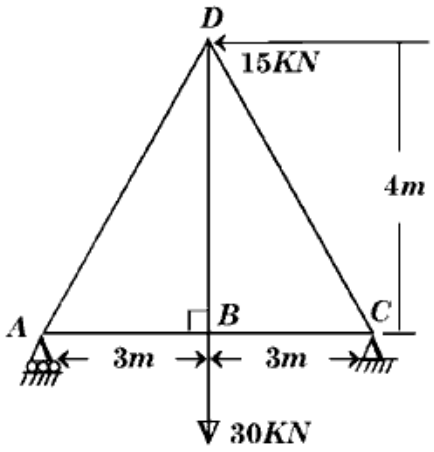


**Fig. 2**

c) Draw the SF and B.M Diagram for the beam shown in **fig.3**.

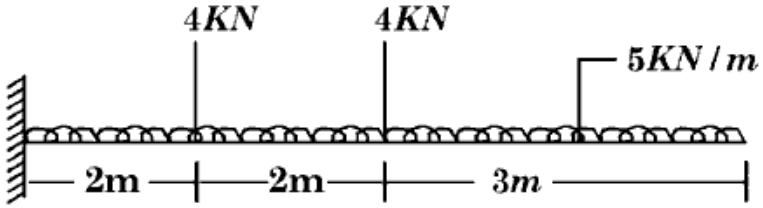


**Fig. 3**





**5** Attempt any **four** parts of the following : **5×4=20**

a) Draw stress-strain curve for a ductile and brittle material on a simple diagram. What are the differences between these two curves.

b) Determine the stress in all the three sections and total deformation of the steel rod shown in **Fig.4**. Cross sectional area = **10cm$^2$, E=200 GN/m$^2$**

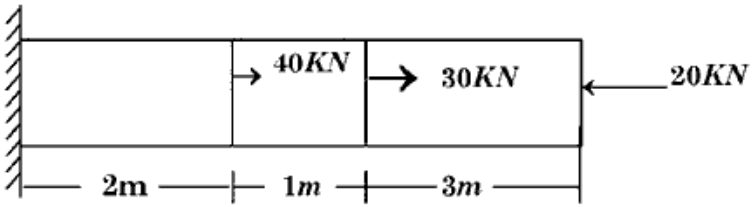


**Fig. 4**

c) Calculate the normal and shear stress on the plane inclined at an angle **60°** for the stress shown in **fig.5.** Also calculate the value of principal stress and its location.

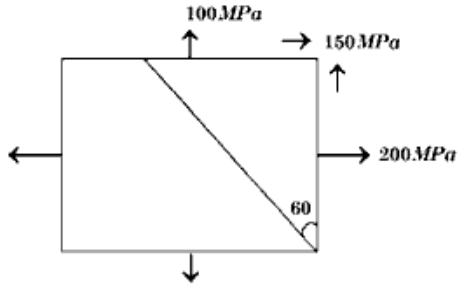


**Fig. 5**

d) Derive the torsion formula.

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

Enumerate the assumptions that are made in deriving this formula.

e) Determine the dimensions of a simply supported rectangular steel beam 6m long to carry a brick wall **250 mm** thick and **3 m** high, if the brick work weights **19.2 kN/m$^3$** and maximum permissible bending stress is **800 N/cm$^2$**. The depth of beam is **3/2** times its width.

f) A solid circular shaft transmits **75 kW** power at **180 rpm.** Calculate the shaft diameter if the twist in the shaft is not to exceed **1** degree in **2 m** length and shear stress is limited to **50MN/m$^2$.** Take modules of rigidity **G = 100GN/m$^2$.**