Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

KT Examination

June2018

Maximum Marks: **100** Duration: **3 hour**

Class: **S.Y.B.Tech** Semester: **III** Program:**Mechanical Engineering**

Name of the Course: ~~Applied~~ Engg **Mathematics III** Course Code :BTM301

Instructions:

- Attempt any FOUR questions out of remaining SIX questions.
- Question number.**1** is **compulsory**.
- Answers to all sub questions should be **grouped** together.

Q		**Marks**	**CO**	**Module No.**
1(a)	Find the characteristic equation of the symmetric matrix $A=\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and verify that it is satisfied by A and hence obtain A^{-1}. Express $A^6-6A^5+9A^4-2A^3-12A^2+23A-9I$ in linear polynomial in A.	**5**	**4**	**7**
(b)	Find Laplace transforms of $f(t)=\sin^4 t$	**5**	**1**	**1**
(c)	Find a Fourier series to represent, $f(x)=\pi-x$ for $0<x<2\pi$.	**5**	**2**	**4**
(d)	Show that the function $u(x,y)=4xy-3x+2$ is harmonic. Construct the corresponding analytic function	**5**	**3**	**5**

	$f(z)=u(x,y)+iv(x,y)$			
2 (a)	Find the eigen values and the corresponding eigenvectors of the following matrix $\begin{bmatrix}1&2&3\\2&4&6\\3&6&9\end{bmatrix}$	6	4	7
(b)	Prove that $\int_0^{\infty}\frac{e^{-t}\sin^2 t}{t}dt=\frac{1}{4}\log 5$	6	1	2
(c)	Obtain the half range sine series for $f(x)=\begin{cases}\frac{2x}{3} & 0\le x\le\frac{\pi}{3}\\ \frac{\pi-x}{3} & \frac{\pi}{3}\le x\le\pi\end{cases}$	8	2	5
3 (a)	Prove that the following function is analytic $f(z)=\cosh z$	6	3	5
(b)	Show that $A=\begin{bmatrix}\cos\theta&0&\sin\theta\\0&1&0\\-\sin\theta&0&\cos\theta\end{bmatrix}$ is an orthogonal matrix.	6	4	7
(c)	Find $\mathcal{L}\left\{\frac{d}{dt}\left(\frac{\sin t}{t}\right)\right\}$	8	1	1
4 (a)	Find the Fourier series corresponding to the function f (x) defined in $(-2,2)$ as follows $f(x)=2$ in $-2\le x\le 0$ $=x$ in $0<x<2$	6	2	4
4(b)	**Find the Laplace transforms of f(t), where** $f(t)=\begin{cases}t, & 0<t<4\\ 5, & t>4\end{cases}$	6	1	1
4©	Find the image of the circle $\|z-1\|=1$ in the complex plane under the mapping $w=\frac{1}{z}$.	8	3	5

5 (a)	Evaluate: $\mathcal{L}^{-1}\left\{\frac{2s-1}{s^3+s}\right\}$	6	1	2
(b)	If $A=\begin{bmatrix}3 & -3 & 4\\ 2 & -3 & 4\\ 0 & -1 & 1\end{bmatrix}$, Find two non singular matrices P and Q such that PAQ = I. Hence find A^{-1}.	6	4	6
(c)	Obtain the half range sine series for $f(x)=\begin{cases}\frac{2x}{3} & 0\le x\le \frac{\pi}{3}\\ \frac{\pi-x}{3} & \frac{\pi}{3}\le x\le \pi\end{cases}$	8	2	4
6(a)	Evaluate: $\mathcal{L}^{-1}\left\{\frac{s}{(s+1)(s^2+4)}\right\}$	6	1	2
(b)	For what values of 'a' and 'b' the equations $x+2y+3z=4$, $x+3y+4z=5$, $x+3y+az=b$ have iv) No solution v) A unique solution vi) Infinite number of solutions	6	4	6
(c)	Find the analytic function $f(z)=u+iv$ such that $u-v=e^x(\cos y-\sin y)$	8	3	5
7 (a)	Obtain complex form of the Fourier series of the function the $f(x)=\begin{cases}0 & -\pi\le x\le 0\\ 1 & 0\le x\le \pi\end{cases}$	6	2	4
(b)	Evaluate: $\mathcal{L}^{-1}\left\{\frac{3s+7}{4s^2-25}\right\}$	6	1	2
(c)	Solve $\frac{dy}{dt}+2y+\int_0^t y\,dt=\sin t$ Given $y(0)=1$	8	1	2

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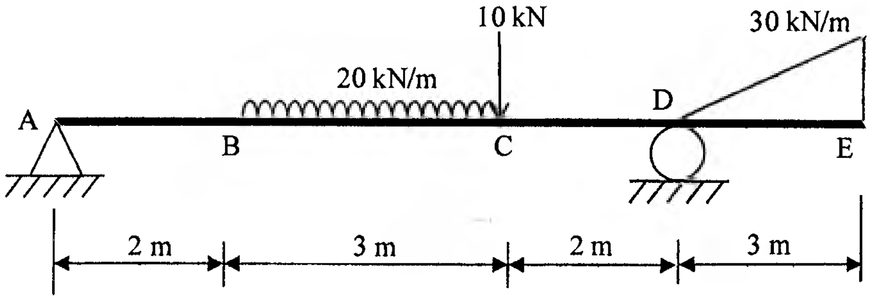
Re-Examination
June 2018

Program: **B.Tech. in Mechanical Engineering** Date: **June 2018**
Class: **S.Y. B.Tech. (Mechanical)** Duration: **3 Hr.**
Course code: **BTM302** Max. Points: **100**
Name of the Course: **Strength of Materials** Semester: **III**

Instructions:

- Question No 1 is **compulsory**. Attempt any four questions out of remaining six.
- Assume suitable data if necessary.

		Max. Points	CO No.	Module No.
Q1 A)	Draw a neat sketch of typical stress-strain diagram for mild steel. Indicate important terms related to the mechanical properties of steel on the diagram.	(5)	3	1
B)	A rectangular beam section 30 mm wide and 90 mm depth is subjected to a moment of 5 kNm. Determine the maximum stress in the beam. Also calculate the radius of curvature of neutral axis at this section. Consider $E = 2x10^5$ N/mm^2.	(5)	2	4
C)	A round bar of cross sectional area A and length L is mounted vertically with its top end fixed. If density of bar material is ρ, formulate expression for extension of the bar at the free end due to its self-weight.	(5)	2	2
D)	Construct Mohr circle diagram for any point on outside surface of loaded components in following cases: (i) a steel bar subjected to pure tensile load, (ii) a steel shaft subjected to pure torque, (iii) a rubber rod subjected to pure bending moment, (iv) cylinder subjected to internal pressure, (v) sphere subjected to internal pressure.	(5)	4	5
Q2 A)	Develop the shear force and bending moment diagram for the beam ABCDE shown in the figure.	(15)	1	3



		Max. Points	CO No.	Module No.
B)	A spherical vessel, 1000 mm in diameter is subjected to an internal pressure of 1.5 MPa. Find the thickness of plate required if the maximum stress is not to exceed 100 MPa. Also calculate diametrical expansion of the sphere. E = 200 GPa and $\nu = 0.3$.	(5)	2	7

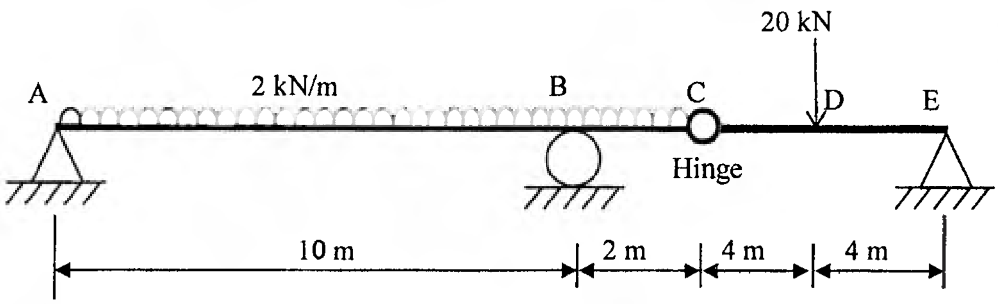
Q3 A) The stress-strain data of a tensile test carried on a material is tabulated below. **(10)** *3* *1*

σ (MPa)	200	400	505	590	640	655	665	675
ε (mm/mm)	0.0012	0.0024	0.003	0.004	0.006	0.007	0.0085	0.0100

Plot the stress-strain data on graph paper and obtain the value of 0.2% offset proof stress. Determine graphically the modulus of elasticity and stress corresponding to 0.5% strain.

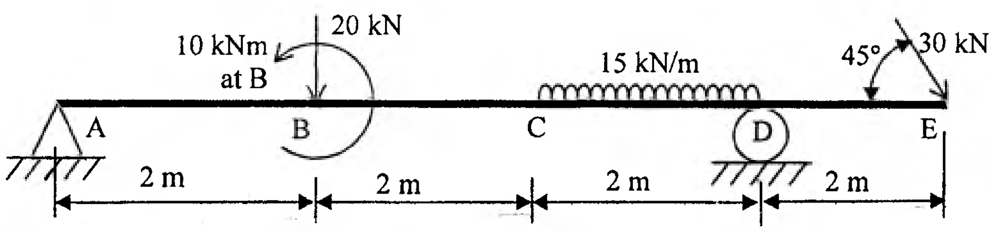
B) An I-section 600 mm x 300 mm having flange thickness of 15 mm and web thickness of 10 mm is subjected to shear force of 800 kN. Determine the maximum and minimum shear stress in the web. Also calculate the percentage of vertical shear carried only by the web of the beam. **(10)** *2* *4*

Q4 A) Draw shear force and bending moment diagram for the beam ABCDE with internal hinge at C as shown in the figure. **(10)** *1* *3*



B) A hollow shaft is subjected to torque of 800 kNm and a bending moment of 500 kNm. The internal diameter of shaft is one-fourth of the external diameter. If the maximum shear stress in not to exceed 180 MPa, find diameter of the shaft. Also draw Mohr circles corresponding to point subjected to maximum stress on (i) outer and (ii) inner surface of the shaft. **(10)** *4* *5*

Q5 A) Calculate the transverse deflection of beam ABCDE shown in the figure at location 'E' using Macaulay's method. E = 200 GPa and I = 2 x10^{-5} m^4. **(10)** *2* *6*



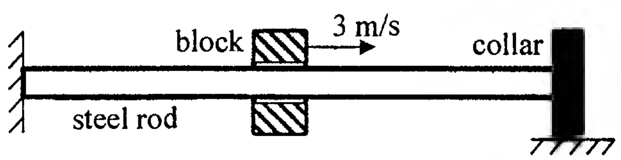
B) A brittle steel rod is heated to 400°C and then suddenly clamped at both ends. On gradual cooling, the bar breaks at 200°C. Determine the breaking stress of this steel. Consider E = 200 GPa, α = 12 x 10^{-6} mm/mm/°C. **(10)** *2* *2*
If the rod is gradually heated after clamping (instead of cooling), at which temperature it would get crushed? Assume crushing strength is double of the tensile breaking strength and the strength is independent of temperature.

If the rod after clamping, is suddenly cooled by spraying with jets of cold water on its surface, contrast the nature of stresses in this situation against those induced during gradual cooling case.

Q6 A) Formulate the expression for deflection and slope (i) at the free end of a cantilever beam (length *l* and area moment of inertia *I*) subjected to point load *W* at its free end and (ii) at the center of simply supported beam (length *l* and area moment of inertia *I*) subjected to point load *W* at its center of length. Use double integration method. **(10)** *2* *6*

B) Define thick and thin cylinders in the context of components subjected to pressure loading. State the Lame's equations for analysis of stresses in thick cylinder. Explain how these equations can be employed for design of thick cylinders to limit stresses and deformations within specified limits. Propose a method to evaluate stresses in an internally pressurized thick cylinder with its wall thickness varying across cylinder's length. **(10)** *1* *7*

Q7 A) A sliding block weighing 300 N slides over a 30 mm diameter 3000 mm long horizontal steel rod at a velocity of 3 m/s as shown in the figure. The block is stopped by its impact with a rigid collar provided at the end of rod. Ignoring friction and bending of bar, find instantaneous stress and elongation induced in the rod. Consider E = 200 GPa. What would be effect, if any, on the stress induced if the rod is made of aluminum with same dimensions. **(5)** *4* *2*



B) Define following terms: (i) Young's modulus, (ii) Poisson's ratio, (iii) Impact strength, (iv) Brinell hardness number, (v) Shear strain. **(5)** *3* *1*

C) State the assumptions made during the derivation of classical bending stress formula. **(5)** *2* *4*

D) Name two theories of failure employed in Mechanical Engineering. For each of the theory explain its failure criterion. Represent these theories graphically on principal stress plane. Discuss which theory is safer to use. Can you name a theory of failure which is based on a failure criterion other than the one mentioned by you above? **(5)** *4* *5*

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RE-EXAM (ODD SEM)
June 2017

Class: S. Y. B. Tech (Mechanical). **Total Marks: 100**

Course: Machine Drawing **Time: 3 hrs**

Course Code: BTM303

Note:

- Question no. 1 is compulsory.
- Attempt any four out of remaining six questions.
- Use only drawing sheet to answer.
- Assume suitable data if necessary.

Q. No.			Module /CO.No.	Marks
Q.1	(a)	Draw Free Hand Sketches of the following: i) Square Nut ii) Hexagonal headed Bolt iii) Plain Stud iv) Unified Thread	02/02	12
	(b)	A vertical cone, diameter of base 75 mm and axis 100 mm long, is completely penetrated by a cylinder of 40 mm diameter. The axis of the cylinder is parallel to the H.P. and the V.P. and intersects the axis of the cone at a 25 mm above base. Draw projections of solids showing curves of intersection.	01/03	08
Q.2	(a)	Given in **Figure 1** are Front View, Partial Side View and Partial Auxiliary View. Draw the Following by First Angle Method i) Front View ii) Partial Top View iii) Full Auxiliary View	01/03	3 4 7
	(b)	Calculate the upper and lower limits for Ø 30 H8/f7.	02/01	06
Q.3	(a)	Given in **Figure 2** is the detail drawing of Spigot and Socket Joint. Imagine the parts assembled and draw of the following views. i) Sectional Front View ii)Top View	03/01	16
	(b)	Show different types of fits via Hole basis system.	02/01	04
Q.4	(a)	Given in the **Figure 3** is the assembly drawing of Oldham's Coupling. Draw the following views of the parts given below: (i) Flange B: Sectional Front View & Side View (ii) Disc: Front View	04/01	08 04
	(b)	Draw the free hand sketches of the following: i) Round Key ii) Gib Headed key	03/02	06

Q.5	(a)	Given in the **Figure 4** is the assembly of Fast and Loose Belt Pulley. Draw the following views of assembly: i) Sectional Front View ii) Side View	05/03	 10 06
	(b)	Draw the conventional representation of the following bearings: (i) Double Ball bearing (ii) Roller bearing	04/02	02 02
Q.6		Given in the **Figure 5** is the detail drawing of non – return valve. Imagine the parts assembled and draw the following: a) Sectional Front View b) Bill of Material	06/01	 16 04
Q.7		Given in **Figure 6** is the assembly of Drill Jig. Draw the detail views of following parts: a) Base Plate - i) Sectional Front View ii) Top View b) Stem – Sectional Front View c) Latch Washer – Top View	07/01	 06 04 06 04

Limits, Tolerance Tables

Table 1 Recommended diameter steps upto 500 mm (13 steps)

Over	-	3	6	10	18	30	50	80	120	180	250	315	400
Upto	3	6	10	18	30	50	80	120	180	250	315	400	500

Table 2 Equations to calculate fundamental deviation of shaft size up to 500 mm (D = Geometrical mean dia. in mm)

Symbol	Fundamental deviation in microns	Symbol	Fundamental deviation in microns
d	$-16D^{0.44}$	js	$\pm (IT/2)$
e	$-11D^{0.41}$	k4 to k7	$+0.63D^{1/2}$
f	$-5.5D^{0.41}$	m	+ (IT7 – IT6)
g	$-2.5D^{0.34}$	n	$+5D^{0.34}$
h	0	p	+ (IT7 + 0 to 5)

Table 3 Fundamental Tolerance for IT grades in terms of i.

IT Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Tolerance in Microns	7i	10i	16i	25i	40i	64i	100i	160i	250i	400i	640i	1000i

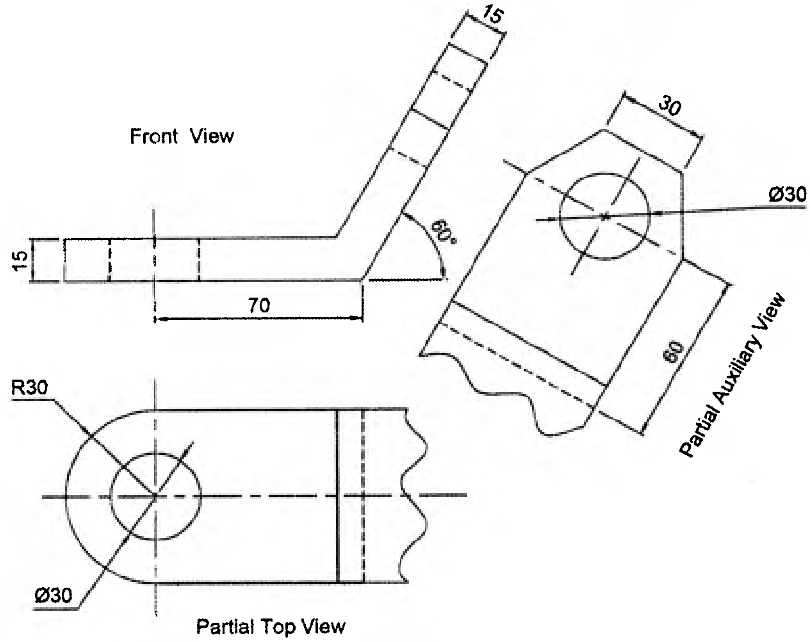


Figure 1

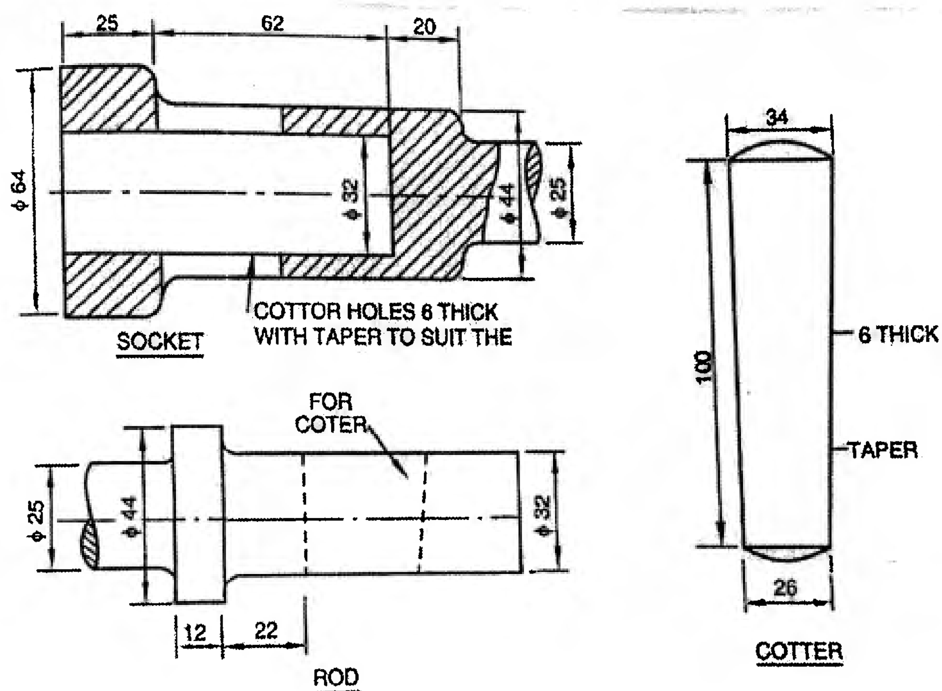


Figure 2

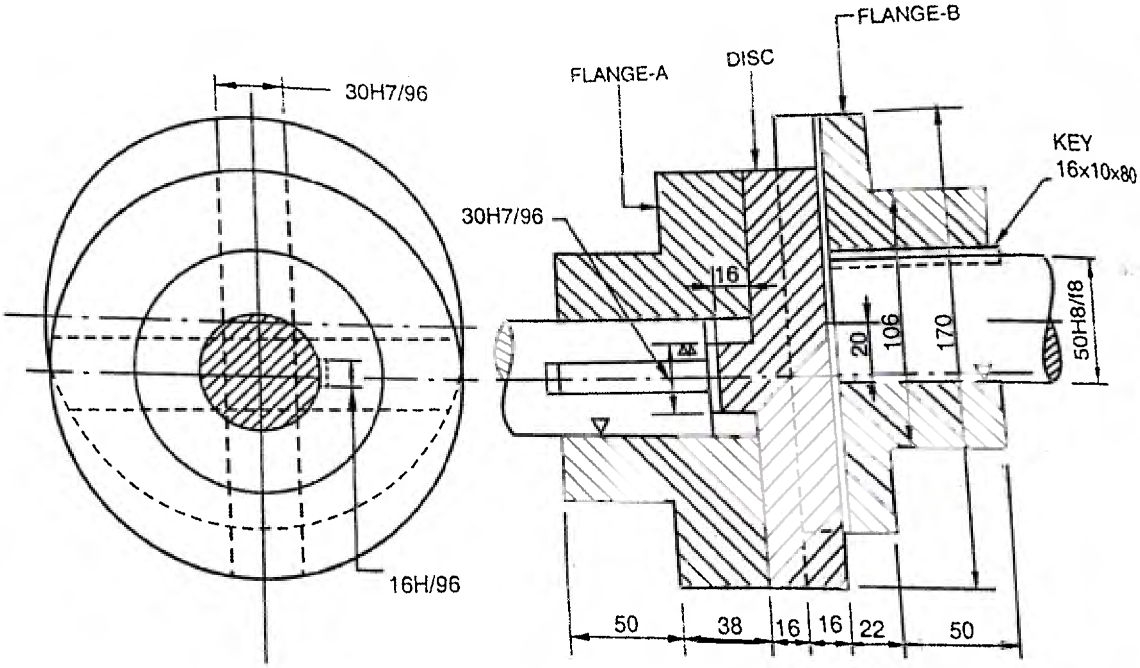


Figure 3

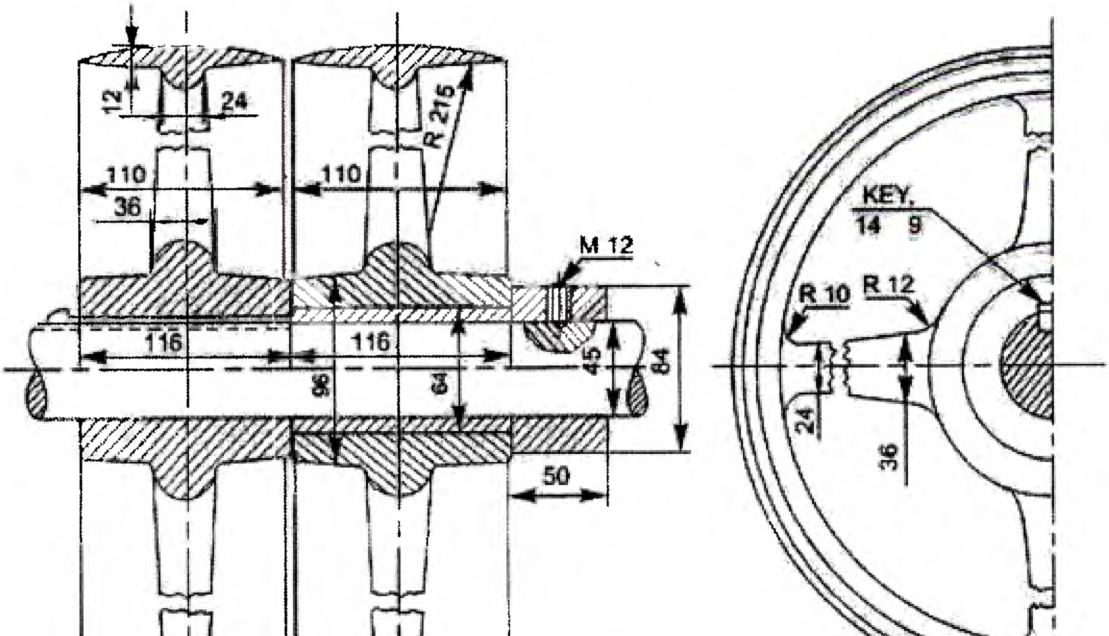


Figure 4

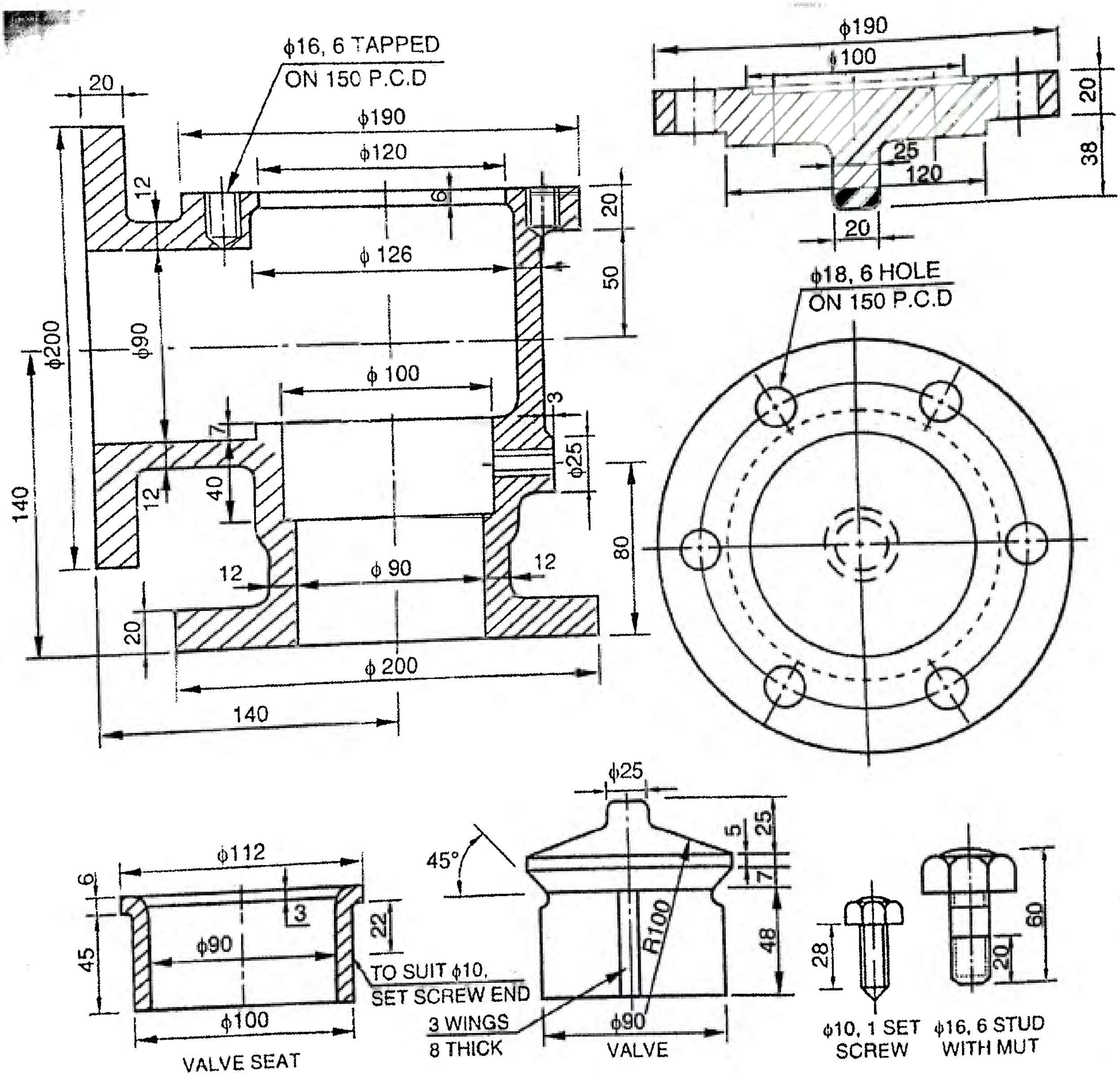
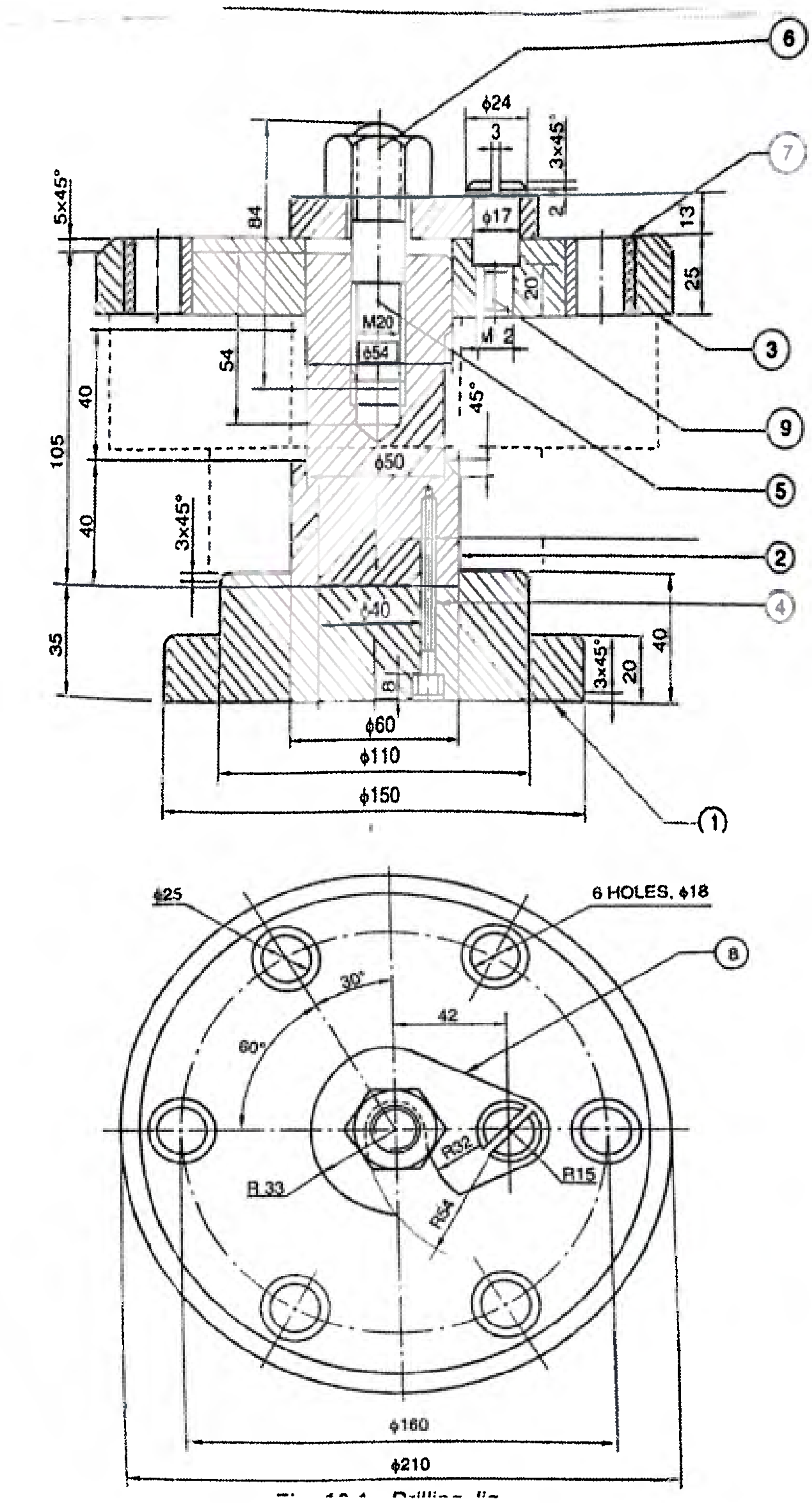


Figure 5

Pg 5/6



6
ϕ24
3
3×45°
7
5×45°
84
ϕ17
2
13
25
M20
ϕ54
20
2
M
3
54
9
45°
40
105
ϕ50
5
3×45°
40
2
4
ϕ40
35
8
3×45°
20
40
ϕ60
ϕ110
ϕ150
1
ϕ25
6 HOLES, ϕ18
8
30°
42
60°
R 33
R32
R15
R64
ϕ160
ϕ210

Figure 6

Mech odd

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RE-EXAMINATION ODD SEMESTER

Program: **B. Tech. in Mechanical Engineering**	Date: **June -2018**
Class: **Second Year B. Tech. (Mechanical)**	Duration: **3 Hr.**
Course code: **BTM 305**	Max. Points: **100**
Name of the Course: **Thermodynamics**	Semester: **III**

Instructions:

- Attempt **ANY 05** questions.
- Assume suitable data wherever necessary and state the same.
- Draw **neat** and lebelled system diagram **and/or** process diagram wherver necessary.
- **Legible hand writing,** proper figures and tidy work carry weightage.
- Refer **Steam Tables and Mollier Diagram** wherever necessary.
- Answers to theory questions should be **brief and prescise.**

		Max. Points	CO No.	Module No.
Q 1	A) **Explain:**-i) Thermodynamic Equilibrium ii) Quasi-static Process. Give suitable examples.	(10)	1	1
	B) A closed system contains *2 kg* of air at *3 bar, 150°C.* It is stirred and expands till its pressure reduces to *1 bar.* During the process, the temperature of the system is maintained constant and the stirrer does the work of *120 kJ.* **Evaluate**:-1) Expansion Work done 2) Heat Transfer. $R = 287\ J/kg.K$ for air.	(10)	1,2,4	1,2
Q 2.	A) **Discuss:**- i) Joule's Experiment ii) PMM-1 and its Converse.	(10)	1,2	2
	B) Air enters a rotary air compressor at *6 m/s, 1 bar* and $0.85\ m^3/kg$. It flows steadily at a rate of *0.4 kg/s* and leaves at *4.5 m/s, 6 9 bar* and $0.16\ m^3/kg$. The internal energy of air leaving is *88 kJ/kg* more than that of air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from compressed air at the rate of *59 W.* **Evaluate:-** i) Power required to drive the compressor ii) Compressor inlet and outlet cross-sectional areas.	(10)	1,2,4	2
	A) **Explain:-** Working of Ideal Rankine cycle with details of processes involved, using a neat schematic and p-V , T-s and h-s diagrams.	(10)	1,3	5
	B)Steam at a pressure of 15 bar and 250 °C is expanded isentropically through a turbine at first to a pressure of 4 bar. It is then reheated at constsnt pressure to the initial temperature of 250 °C and is finally expanded to 0.1 bar. **Evaluate:-** i) Thermal Efficiency of Cycle ii) Work output per kg of steam flowing through the turbine.	(10)	1,3,4	5

Q.4	A) **Explain:-**Working of an Ideal Otto cycle with p-v and T-s diagrams. **Prove**:-Eefficiency of an ideal Otto Engine is independent of operating temperatures and depends only on Compression ratio of the engine.	(10)	1,3	6
	B) An ideal Diesel engine operates within the temperature limits of $1700K$ *and* $300K$ with a compression ratio of 16. **Evaluate:-** i)Pressures and temperatures at cardinal points ii) Thermal efficiency of the cycle.	(10)	1,3,4	6
Q.5	A) **Explain**: with a neat and labelled T-s diagram,- i) Critical Point ii) Triple Point,iii) Compressed Liquid iv) Liquid-Vapour Mixture v) Superheted Vapour.	(10)	1,3,4	5
	C) A Gas Turbine power plant working on an ideal Brayton Cycle receives air at the inlet to the compressor at $0.1\ MPa$ and $30°C$. The pressure ratio of the cycle is *6*. Maximum temperature in the cycle is $900\ °C$. **Evaluate**:-Efficiency of the gas turbine power plant with polytropic efficiency of compressor and turbine as 100%. each.	(10)	1,3,4	6
Q.6	A) **Explain:-**Working of Ideal Vapor Compression Refrigeration Cycle explaining the details of processes involved uisng a neat schematic and T-s and p-H diagrams.	(10)	1,2	7
	B) Explain the priniciple and working of heat pump and refrigerator with neat sketches and **Prove**:- $COP_{HP} = 1 + COP_R$;	(10)	1,3	3,7
Q.7	**Explain** the following with neat sketches and illustrative examples:- i) Zeroth Law of Thermodynamics and International Practical Temperature Scale (IPTS) ii) Statements of Second Law of Thermodynamics iii) Dead State, Availability and Available Energy	(20)	1,2,3	3,4

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KT Examination

June2018

Maximum Marks: **100** Duration: **3 hour**

Class: **S.Y.B.Tech** Semester: **III** Program:**Mechanical Engineering**

Name of the Course: ~~Applied~~ Engg **Mathematics III** Course Code :BTM301

Instructions:

- Attempt any FOUR questions out of remaining SIX questions.
- Question number.**1** is **compulsory**.
- Answers to all sub questions should be **grouped** together.

Q		Marks	CO	Module No.
1(a)	Find the characteristic equation of the symmetric matrix $A=\begin{bmatrix}2 & -1 & 1\\ -1 & 2 & -1\\ 1 & -1 & 2\end{bmatrix}$ and verify that it is satisfied by A and hence obtain A^{-1}. Express $A^6-6A^5+9A^4-2A^3-12A^2+23A-9I$ in linear polynomial in A.	5	4	7
(b)	Find Laplace transforms of $f(t)=\sin^4 t$	5	1	1
(c)	Find a Fourier series to represent, $f(x)=\pi-x$ for $0<x<2\pi$.	5	2	4
(d)	Show that the function $u(x,y)=4xy-3x+2$ is harmonic. Construct the corresponding analytic function	5	3	5

	$f(z)=u(x,y)+iv(x,y)$			
2 (a)	Find the eigen values and the corresponding eigenvectors of the following matrix $\begin{bmatrix}1 & 2 & 3\\ 2 & 4 & 6\\ 3 & 6 & 9\end{bmatrix}$	6	4	7
(b)	Prove that $\int_0^{\infty}\frac{e^{-t}\sin^2 t}{t}dt=\frac{1}{4}\log 5$	6	1	2
(c)	Obtain the half range sine series for $f(x)=\begin{cases}\frac{2x}{3} & 0\le x\le\frac{\pi}{3}\\ \frac{\pi-x}{3} & \frac{\pi}{3}\le x\le\pi\end{cases}$	8	2	5
3 (a)	Prove that the following function is analytic f(z)= cosh z	6	3	5
(b)	Show that $A=\begin{bmatrix}\cos\theta & 0 & \sin\theta\\ 0 & 1 & 0\\ -\sin\theta & 0 & \cos\theta\end{bmatrix}$ is an orthogonal matrix.	6	4	7
(c)	Find $\mathcal{L}\left\{\frac{d}{dt}\left(\frac{\sin t}{t}\right)\right\}$	8	1	1
4 (a)	Find the Fourier series corresponding to the function f (x) defined in $(-2,2)$ as follows $f(x)=2$ in $-2\le x\le 0$; $=x$ in $0<x<2$	6	2	4
4(b)	**Find the Laplace transforms of f(t), where** $f(t)=\begin{cases}t, & 0<t<4\\ 5, & t>4\end{cases}$	6	1	1
4©	Find the image of the circle $\lvert z-1\rvert=1$ in the complex plane under the mapping $w=\frac{1}{z}$.	8	3	5

5 (a)	Evaluate: $\mathcal{L}^{-1}\left\{\frac{2s-1}{s^3+s}\right\}$	6	1	2
(b)	If $A=\begin{bmatrix}3 & -3 & 4\\ 2 & -3 & 4\\ 0 & -1 & 1\end{bmatrix}$, Find two non singular matrices P and Q such that PAQ = I. Hence find A^{-1}.	6	4	6
(c)	Obtain the half range sine series for $f(x)=\begin{cases}\frac{2x}{3} & 0\le x\le\frac{\pi}{3}\\ \frac{\pi-x}{3} & \frac{\pi}{3}\le x\le\pi\end{cases}$	8	2	4
6(a)	Evaluate: $\mathcal{L}^{-1}\left\{\frac{s}{(s+1)(s^2+4)}\right\}$	6	1	2
(b)	For what values of 'a' and 'b' the equations $x+2y+3z=4$, $x+3y+4z=5$, $x+3y+az=b$ have iv) No solution v) A unique solution vi) Infinite number of solutions	6	4	6
(c)	Find the analytic function $f(z)=u+iv$ such that $u-v=e^x(\cos y-\sin y)$	8	3	5
7 (a)	Obtain complex form of the Fourier series of the function the $f(x)=\begin{cases}0 & -\pi\le x\le 0\\ 1 & 0\le x\le\pi\end{cases}$	6	2	4
(b)	Evaluate: $\mathcal{L}^{-1}\left\{\frac{3s+7}{4s^2-25}\right\}$	6	1	2
(c)	Solve $\frac{dy}{dt}+2y+\int_0^t y\,dt=\sin t$ Given $y(0)=1$	8	1	2

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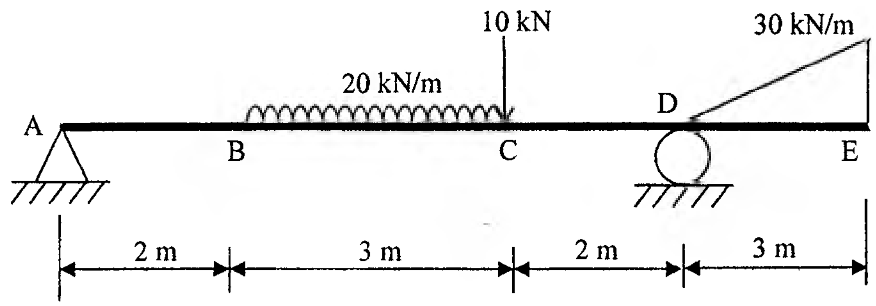
Re-Examination
June 2018

Program:	**B.Tech. in Mechanical Engineering**	Date: **June 2018**	
Class:	**S.Y. B.Tech. (Mechanical)**	Duration: **3 Hr.**	
Course code:	**BTM302**	Max. Points: **100**	
Name of the Course:	**Strength of Materials**	Semester: **III**	

Instructions:

- Question No 1 is compulsory. Attempt any four questions out of remaining six.
- Assume suitable data if necessary.

Q.		Question	Max. Points	CO No.	Module No.
Q1	A)	Draw a neat sketch of typical stress-strain diagram for mild steel. Indicate important terms related to the mechanical properties of steel on the diagram.	**(5)**	*3*	*1*
	B)	A rectangular beam section 30 mm wide and 90 mm depth is subjected to a moment of 5 kNm. Determine the maximum stress in the beam. Also calculate the radius of curvature of neutral axis at this section. Consider $E = 2x10^5\ N/mm^2$.	**(5)**	*2*	*4*
	C)	A round bar of cross sectional area A and length L is mounted vertically with its top end fixed. If density of bar material is ρ, formulate expression for extension of the bar at the free end due to its self-weight.	**(5)**	*2*	*2*
	D)	Construct Mohr circle diagram for any point on outside surface of loaded components in following cases: (i) a steel bar subjected to pure tensile load, (ii) a steel shaft subjected to pure torque, (iii) a rubber rod subjected to pure bending moment, (iv) cylinder subjected to internal pressure, (v) sphere subjected to internal pressure.	**(5)**	*4*	*5*
Q2	A)	Develop the shear force and bending moment diagram for the beam ABCDE shown in the figure.	**(15)**	*1*	*3*



Q.		Question	Max. Points	CO No.	Module No.
	B)	A spherical vessel, 1000 mm in diameter is subjected to an internal pressure of 1.5 MPa. Find the thickness of plate required if the maximum stress is not to exceed 100 MPa. Also calculate diametrical expansion of the sphere. E = 200 GPa and $\nu = 0.3$.	**(5)**	*2*	*7*

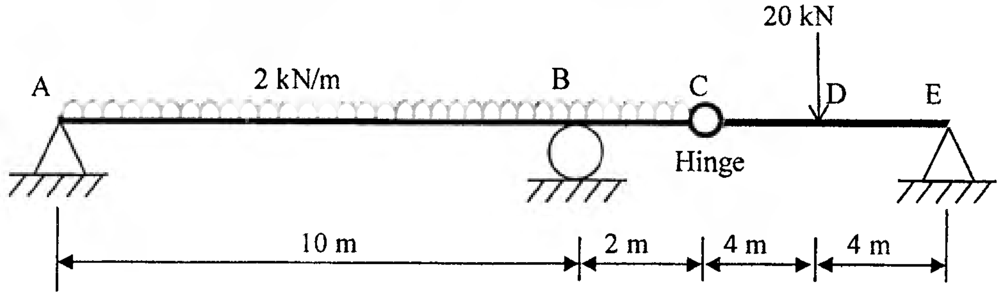
Q3 A) The stress-strain data of a tensile test carried on a material is tabulated below. **(10)** *3* *1*

σ (MPa)	200	400	505	590	640	655	665	675
ε (mm/mm)	0.0012	0.0024	0.003	0.004	0.006	0.007	0.0085	0.0100

Plot the stress-strain data on graph paper and obtain the value of 0.2% offset proof stress. Determine graphically the modulus of elasticity and stress corresponding to 0.5% strain.

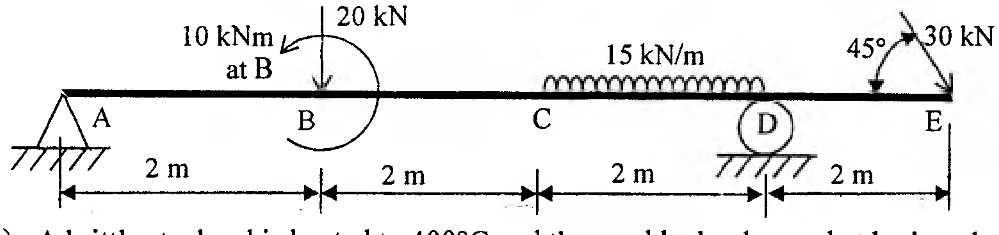
B) An I-section 600 mm x 300 mm having flange thickness of 15 mm and web thickness of 10 mm is subjected to shear force of 800 kN. Determine the maximum and minimum shear stress in the web. Also calculate the percentage of vertical shear carried only by the web of the beam. **(10)** *2* *4*

Q4 A) Draw shear force and bending moment diagram for the beam ABCDE with internal hinge at C as shown in the figure. **(10)** *1* *3*



B) A hollow shaft is subjected to torque of 800 kNm and a bending moment of 500 kNm. The internal diameter of shaft is one-fourth of the external diameter. If the maximum shear stress in not to exceed 180 MPa, find diameter of the shaft. **(10)** *4* *5*
Also draw Mohr circles corresponding to point subjected to maximum stress on (i) outer and (ii) inner surface of the shaft.

Q5 A) Calculate the transverse deflection of beam ABCDE shown in the figure at location 'E' using Macaulay's method. E = 200 GPa and I = 2 x10^{-5} m^4. **(10)** *2* *6*



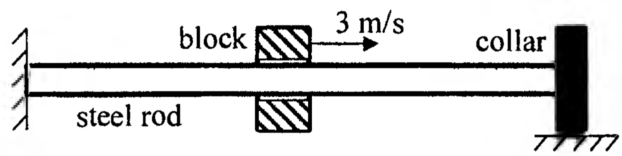
B) A brittle steel rod is heated to 400°C and then suddenly clamped at both ends. On gradual cooling, the bar breaks at 200°C. Determine the breaking stress of this steel. Consider E = 200 GPa, α = 12 x 10^{-6} mm/mm/°C. **(10)** *2* *2*
If the rod is gradually heated after clamping (instead of cooling), at which temperature it would get crushed? Assume crushing strength is double of the tensile breaking strength and the strength is independent of temperature.

If the rod after clamping, is suddenly cooled by spraying with jets of cold water on its surface, contrast the nature of stresses in this situation against those induced during gradual cooling case.

Q6 A) Formulate the expression for deflection and slope (i) at the free end of a cantilever beam (length *l* and area moment of inertia *I*) subjected to point load *W* at its free end and (ii) at the center of simply supported beam (length *l* and area moment of inertia *I*) subjected to point load *W* at its center of length. Use double integration method. **(10)** *2* *6*

B) Define thick and thin cylinders in the context of components subjected to pressure loading. State the Lame's equations for analysis of stresses in thick cylinder. Explain how these equations can be employed for design of thick cylinders to limit stresses and deformations within specified limits. Propose a method to evaluate stresses in an internally pressurized thick cylinder with its wall thickness varying across cylinder's length. **(10)** *1* *7*

Q7 A) A sliding block weighing 300 N slides over a 30 mm diameter 3000 mm long horizontal steel rod at a velocity of 3 m/s as shown in the figure. The block is stopped by its impact with a rigid collar provided at the end of rod. Ignoring friction and bending of bar, find instantaneous stress and elongation induced in the rod. Consider E = 200 GPa. What would be effect, if any, on the stress induced if the rod is made of aluminum with same dimensions. **(5)** *4* *2*



B) Define following terms: (i) Young's modulus, (ii) Poisson's ratio, (iii) Impact strength, (iv) Brinell hardness number, (v) Shear strain. **(5)** *3* *1*

C) State the assumptions made during the derivation of classical bending stress formula. **(5)** *2* *4*

D) Name two theories of failure employed in Mechanical Engineering. For each of the theory explain its failure criterion. Represent these theories graphically on principal stress plane. Discuss which theory is safer to use. Can you name a theory of failure which is based on a failure criterion other than the one mentioned by you above? **(5)** *4* *5*

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Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058

RE-EXAMINATION ODD SEMESTER

Program: **B. Tech. in Mechanical Engineering**
Class: **Second Year B. Tech. (Mechanical)**
Course code: **BTM 305**
Name of the Course: **Thermodynamics**

Date: **June -2018**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **III**

Instructions:

- Attempt **ANY 05** questions.
- Assume suitable data wherever necessary and state the same.
- Draw **neat** and lebelled system diagram **and/or** process diagram wherver necessary.
- **Legible hand writing**, proper figures and tidy work carry weightage.
- Refer **Steam Tables and Mollier Diagram** wherever necessary.
- Answers to theory questions should be **brief and prescise**.

		Max. Points	CO No.	Module No.
Q 1	A) **Explain:**-i) Thermodynamic Equilibrium ii) Quasi-static Process. Give suitable examples.	(10)	1	1
	B) A closed system contains *2 kg* of air at *3 bar*, *150°C*. It is stirred and expands till its pressure reduces to *1 bar*. During the process, the temperature of the system is maintained constant and the stirrer does the work of *120 kJ*. **Evaluate**:-1) Expansion Work done 2) Heat Transfer. $R = 287\ J/kg.K$ for air.	(10)	1,2,4	1,2
Q 2.	A) **Discuss:**- i) Joule's Experiment ii) PMM-1 and its Converse.	(10)	1,2	2
	B) Air enters a rotary air compressor at *6 m/s, 1 bar* and $0.85\ m^3/kg$. It flows steadily at a rate of *0.4 kg/s* and leaves at *4.5 m/s, 6.9 bar* and $0.16\ m^3/kg$ .The internal energy of air leaving is *88 kJ/kg* more than that of air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from compressed air at the rate of *59 W*. **Evaluate:-** i) Power required to drive the compressor ii) Compressor inlet and outlet cross-sectional areas.	(10)	1,2,4	2
	A) **Explain:-** Working of Ideal Rankine cycle with details of processes involved, using a neat schematic and p-V , T-s and h-s diagrams.	(10)	1,3	5
	B)Steam at a pressure of $15\ bar\ and\ 250\ °C$ is expanded isentropically through a turbine at first to a pressure of $4\ bar$. It is then reheated at constsnt pressure to the initial temperature of $250\ °C$ and is finally expanded to $0.1\ bar$. **Evaluate:-** i) Thermal Efficiency of Cycle ii) Work output per kg of steam flowing through the turbine.	(10)	1,3,4	5

Q.4	A) **Explain:-**Working of an Ideal Otto cycle with p-v and T-s diagrams. **Prove**:-Eefficiency of an ideal Otto Engine is independent of operating temperatures and depends only on Compression ratio of the engine.	(10)	1,3	6
	B) An ideal Diesel engine operates within the temperature limits of $1700K$ *and* $300K$ with a compression ratio of 16. **Evaluate:-** i)Pressures and temperatures at cardinal points ii) Thermal efficiency of the cycle.	(10)	1,3,4	6
Q.5	A) **Explain**: with a neat and labelled T-s diagram,- i) Critical Point ii) Triple Point,iii) Compressed Liquid iv) Liquid-Vapour Mixture v) Superheted Vapour.	(10)	1,3,4	5
	C) A Gas Turbine power plant working on an ideal Brayton Cycle receives air at the inlet to the compressor at $0.1\ MPa$ and $30°C$. The pressure ratio of the cycle is *6*. Maximum temperature in the cycle is $900\ °C$. **Evaluate**:-Efficiency of the gas turbine power plant with polytropic efficiency of compressor and turbine as 100%. each.	(10)	1,3,4	6
Q.6	A) **Explain:-**Working of Ideal Vapor Compression Refrigeration Cycle explaining the details of processes involved uisng a neat schematic and T-s and p-H diagrams.	(10)	1,2	7
	B) Explain the priniciple and working of heat pump and refrigerator with neat sketches and **Prove**:- $COP_{HP} = 1 + COP_R$;	(10)	1,3	3,7
Q.7	**Explain** the following with neat sketches and illustrative examples:- i) Zeroth Law of Thermodynamics and International Practical Temperature Scale (IPTS) ii) Statements of Second Law of Thermodynamics iii) Dead State, Availability and Available Energy	(20)	1,2,3	3,4